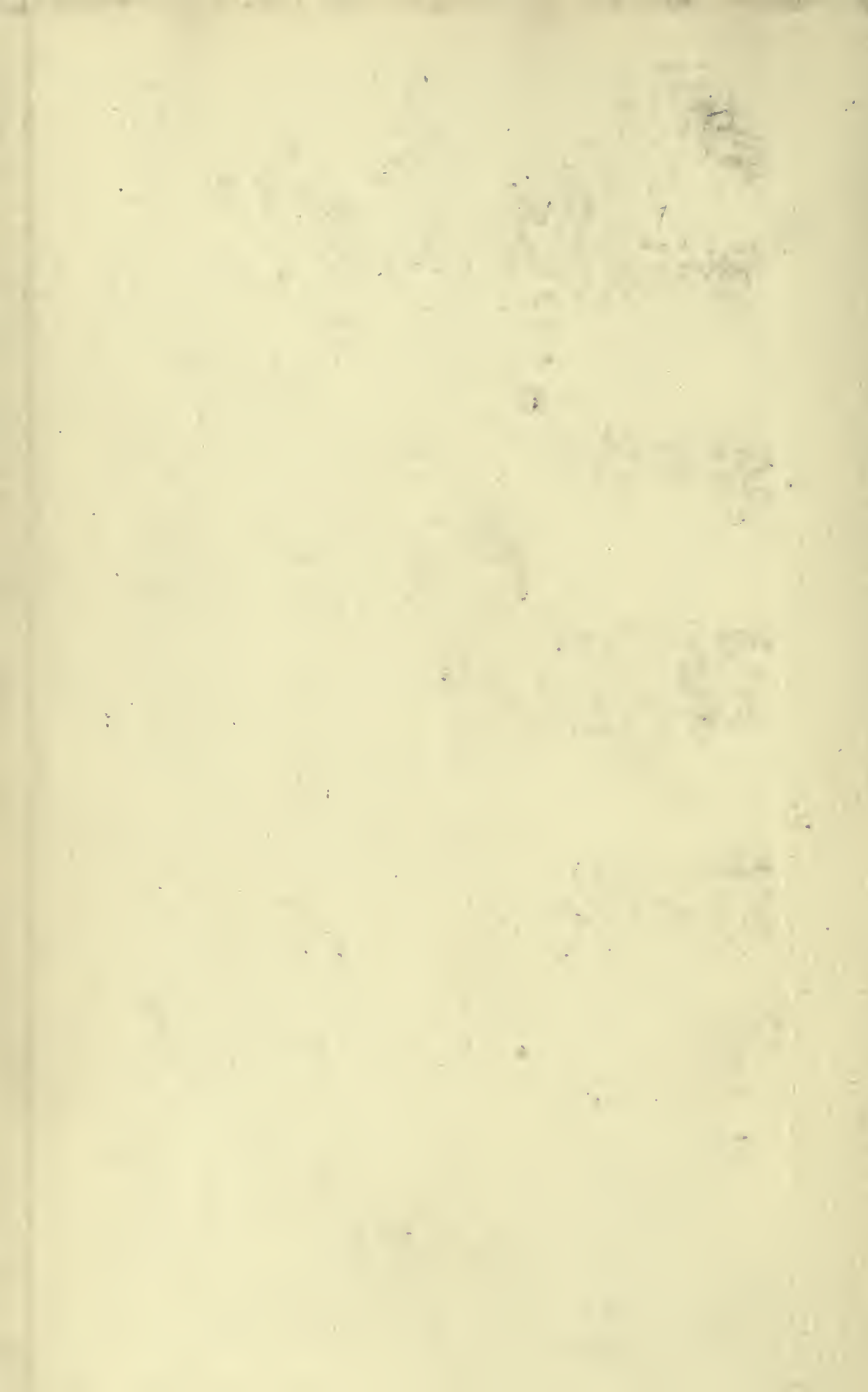




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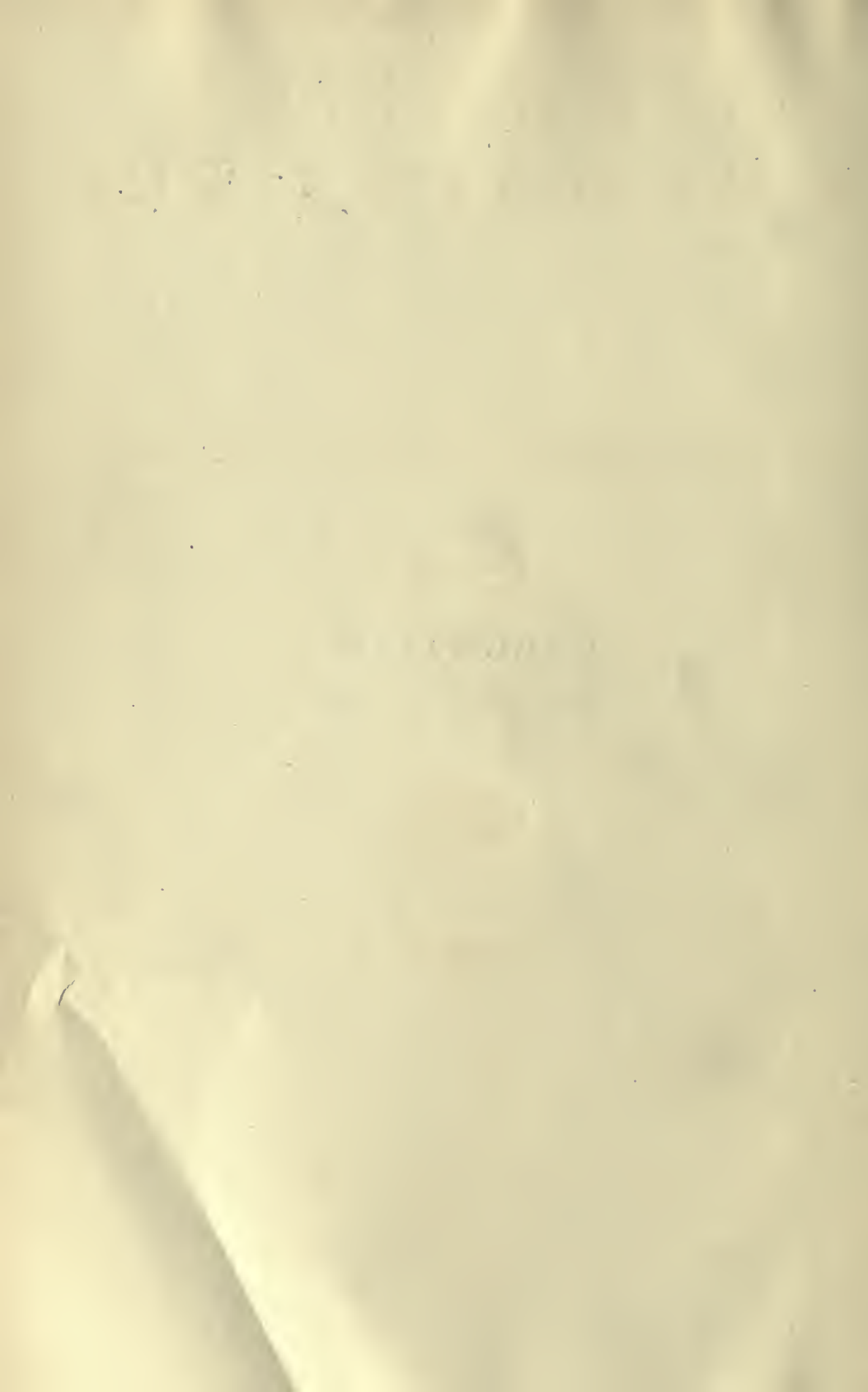






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**OPERATIVE
THERAPEUSIS**



OPERATIVE THERAPEUSIS

EDITED BY
ALEXANDER BRYAN JOHNSON, Ph.B., M.D.

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OPERATIVE THERAPEUSIS

VOLUME V

CHAPTER I

OPERATIONS UPON THE TESTES AND THEIR COVERINGS, SPERMATIC CORD, SEMINAL VESICLES AND SCROTUM, EXCLUDING CONGENITAL DEFECTS

ALFRED T. OSGOOD

Anatomical Considerations.—In operations upon the testes and their coverings, spermatic cord, and scrotum, the following anatomical features are to be considered: The skin of the scrotum and the deeper tissues of its wall are richly supplied with blood-vessels and with elastic tissue which contracts in the separate layers at different levels, rendering the control of bleeding from these parts troublesome. By reason of the laxness and distensibility of the cavity of the scrotum, concealed bleeding or slow oozing of blood into these tissues readily results in the formation of a large hematoma which affords a rich culture medium for bacteria to transform it into a large abscess. It is difficult, often impossible, to produce pressure upon the scrotum and its contents by dressings, bandages, strap-pings, etc., painlessly, so as to control or limit hemorrhage within the sac after operation. For these reasons the accurate control of hemorrhage during operations becomes necessary by clamp, by ligature, or by running suture. The edges of thickened outer layers of a hydrocele sac often require over-and-over suture before the oozing from innumerable fine points can be controlled. The spermatic cord requires great care in its ligation, as in varicocele and castration operations. The stump beyond each ligature should be long to insure against retraction and slipping of ligatures. The veins must often be ligated in 2 or more discrete bundles at the same level. The vas deferens should be separated from the main blood-vessels of the cord and ligated by itself. If the arteries are readily iso-

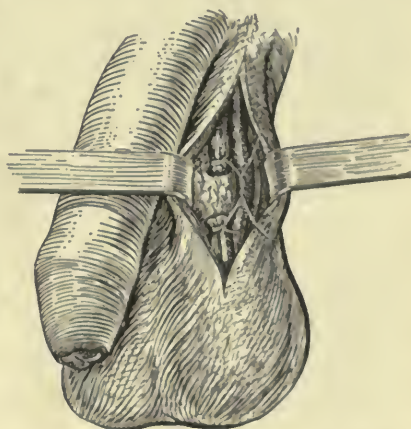


FIG. 1.—INCISION FOR OPERATION UPON THE SPERMATIC CORD AND TESTIS.

lated, it is better surgical technic to ligate each one separately. For operation upon the testis or its coverings or upon the spermatic cord, when the tissues to be treated or removed are normally separable, i. e., not adherent to overlying or surrounding structures, an incision as in Figure 1 may be utilized for many conditions, such as varicocele, orchidectomy, small hydroceles, hydrocele of the cord, vasotomy, etc. Into this incision, by no traumatic stretching, the cord or the testis and its coverings may be delivered with gentle traction on the cord.

Instruments Used.—The following instruments will be required:

Scalpel.

Scissors.

Six artery clamps.

Needle holder.

Needles.

Plain catgut, No. 0 and No. 2.

Silkworm gut.

Adhesive plaster.

Carbolic acid 95 per cent.

Cautery.

Suspensory bandage.

Anesthesia.—Operation upon the scrotum may be performed painlessly with local infiltration (novocain 1 per cent., cocain $\frac{1}{2}$ per cent.) of the skin and of the deeper tissues as the dissection is carried on, so that with care and patience even orchidectomy may be performed with little or no pain in some cases. Ligation of or traction upon the cord, and especially traction upon the vas deferens, may produce severe pain, syncope, and even shock, so that operations which involve dissecting and traction upon the cord should be done under general anesthesia (gas and ether, ether, etc.). Spinal anesthesia (tropococain is best) is usually very satisfactory for operations upon these parts, but in some cases fails apparently for the reason that the anesthetic effect is not exerted upon the sensory roots or centers in the cord up to the high point from which the sensory nerves of the cord arise. Nitrous oxid gas may be administered during the moment or 2 necessary in some cases to complete the dissection of and ligation of the components of the cord. Painful conditions usually require a general anesthetic for complete relief during operation, while varicocele, many hydroceles, etc., may be operated on satisfactorily with local infiltration anesthesia in experienced hands.

OPERATIONS UPON THE TESTIS

ORCHIDOTOMY

Indications.—Isolated abscess of the testis (a rare condition).

Anesthesia.—General or spinal; local infiltration.

Procedure.—Simple incision adequate for drainage into the most prominent portion of the abscess through the tissues of the scrotum.

ORCHIDECTOMY OR REMOVAL OF THE TESTIS AND LOWER PART OF THE SPERMATIC CORD

Indications.—Any lesion of the organ which tends to destroy it or which threatens the life of the individual by its presence.

Abscess.

Neoplasm.

Tuberculosis.

Necrosis from torsion of, or injury to cord.

Anesthesia.—General or spinal; local infiltration (rarely).

Procedure.—Vertical incision in the scrotum 3 cm. in length, or longer, from the level of the external inguinal ring downward. If a sinus is to be removed, as in tuberculosis, the incision should pass in healthy scrotal tissue widely about this. If the vas or tissues of the cord or inguinal glands are to be removed, the incision must extend onward into the groin to comply with these conditions. The cord is exposed and drawn out and with the testis may be delivered through the incision when freed by blunt dissection in the scrotum. In all cases the cord should be ligated before handling a testicular neoplasm, tuberculous lesion, or suppurating or necrotic lesion of the testis, i. e., the lymphatic and vascular channels to the body should be shut off at the earliest moment with as little traumatism as possible. Always ligate the vas as high as possible before removing any part of it or of the epididymis, as in tuberculosis.

The vas should be separated from the other components of the cord, ligated, and its proximal stump cauterized with the actual cautery or pure carbolic acid. If it is tuberculous, it should be carried to the skin surface through a stab wound in the skin and sutured there, or it should be removed entire—not pulled upon and broken off at its weakest (most diseased) point deep in the pelvis, but dissected free as far as possible by opening the inguinal canal, ligated, divided, and cauterized. (For complete removal of the vas, see Excision of Vas, page 16.) The vascular structures of the cord are ligated en masse or in separate bundles, leaving a long (1 cm.) stump below the ligature, divided, and by blunt dissection or cutting with scissors the lower portion of the cord and testis is removed. The incision is closed with a few sutures of silk-worm-gut. Drainage is provided by rubber tissue or tube if soiling of the scrotal tissues or oozing has occurred into the cavity of the scrotum.

EPIDIDYMOTOMY

Extensive suppuration of the epididymis requires incision into the most prominent or most adherent portion of the abscess, which is usually found to be at the posterior portion of the scrotum. It must be borne in mind that the vessels of the cord extend along the inner aspect of the epididymis, and incisions should be made with due regard for the anatomic relations. Incision

into the epididymis will destroy the continuity of the secretory duct of the testis. Since acute epididymitis is often, if not invariably, a multiple abscess involvement, epididymotomy is frequently performed for the relief of this condition. Hagner (Washington, 9) has demonstrated the value of this operation in gonorrheal acute epididymitis and has perfected the technic. The operation then consists in an incision in the lateral surface of the scrotum about 5 cm. to 10 cm. in length over the testis, until its tunica vaginalis is opened. The tunica vaginalis is then everted to expose the enlarged epididymis. The prominent or infiltrated areas of the epididymis are punctured with the tip of a fine knife (tenotome), cutting through only the tunica vaginalis and the sheath or capsule of the epididymis. A blunt probe is inserted into each puncture, and by blunt dissection with it the purulent focus is broken into and escapes through the puncture wound beside the probe. Do not cut into these minute abscesses, for thereby the coiled tube of the epididymis will be divided, and the resulting scar will render this outlet channel of the testis impervious. Multiple punctures through the tissues overlying the swollen parts of the epididymis serve as vents for a drop or so of pus or for a little serum, and manifest relief is afforded the patient from the severe pain which tension has caused. Drainage is provided by a folded piece of rubber tissue or thin rubber dam placed between the testis and epididymis within the tunica vaginalis and brought out through the lower extremity of the incision, which is sutured with a few stitches of silkworm-gut or, as Hagner does, by a subcutaneous stitch of silver wire. The tunica vaginalis may be separately sutured with continuous catgut. The drain is removed at the end of 48 hours. The patient is confined to bed for 5 to 7 days.

Results.—Pain is immediately relieved. Defervescence occurs within 48 hours. Relapse is very rare. Extensive suppuration is prevented. Sterility is less likely to follow than in those not operated on.

ANASTOMOSIS BETWEEN THE TESTIS OR EPIDIDYMIS AND THE VAS DEFERENS

Indications.—Anastomosis between the testis or epididymis and the vas deferens is indicated for the cure of sterility resulting from inflammatory occlusion of the epididymis. When an inflammatory process has destroyed the lumen of the secretory duct of the testis in the epididymis, a channel for the spermatozoa may be provided by this anastomosis.

Anatomical Points.—The vas lies on the inner posterior aspect of the spermatic cord. It should be palpated and brought close to the surface of the skin of the scrotum and anchored there so that an incision may be made in the scrotum close to this point to secure the vas without handling or dissecting the cord. It is evident that the patency of the vas from the point of anastomosis to the urethra is essential to success as well as the determination of the presence of spermatozoa at that part of the testis or epididymis which is to be employed

for the connection with the patent vas. The artery of the vas should not be injured by fingers or instruments.

Anesthesia.—General. Local infiltration may be used.

Instruments Used.—Small instruments, such as those employed for operations upon the eye, are best for this delicate work. The following are required:

Scalpel.

Fine, curved scissors.

Fine, straight scissors with lower blade long and probe-pointed, useful for splitting vas.

Delicate forceps, 2 pairs.

Fine, wire-like, blunt-pointed probe.

Fine, curved needles (conjunctiva needles).

Fine silk or silver wire.

Microscope (and competent observer) to determine presence of spermatozoa.

Microscopic slides, sterilized.

Hypodermic syringe and blunted needle—caliber of hypodermic needle or slightly larger.

Solution, sterilized, of indigocarmine or methylene-blue, saturated or deep color.

Method (Martin).—Pass a small catheter through the urethra into the bladder and close it by a clamp or kinking and tying. With the fingers, bring the vas against the skin of the scrotum at a point in the posterior aspect, on a level with the head of the epididymis, and anchor the vas to the skin by fixing a curved needle through the skin beneath the vas and through the skin on the other side of it.

Incise the skin and tissues of the scrotum and cord overlying the vas, exposing it and extending the skin incision to about $1\frac{1}{2}$ in. Free the vas by careful dissection, avoiding injury to blood-vessels. Make a slit in the vas by means of a fine-pointed tenotome. Insert the blunt hollow needle gently into the lumen of the vas in the direction of its course into the inguinal canal, attach the syringe loaded with sterilized colored solution, and inject slowly about 2 c. c. (℥xxx). Now open the catheter from the bladder and watch for color in the fluid escaping from it.

If fluid is injected freely from the syringe into the vas, it is probable that no stricture of the vas or ampulla is present. If the color appears in the bladder contents, then we have ample proof that the vas, ampulla, and ejaculatory duct offer no obstruction. It may be found that the vas presents a stricture near to the opening into its lumen. In this case, if the strictured point is found, another opening must be made beyond the stricture and another effort made to determine the patency of the remainder of the vas. Cases have been encountered in which multiple stenoses of the vas rendered further procedure in the operation useless. I have met with 2 such experiences. Without this test of the patency of the canal, some failures after operation remain unexplained.

Now expose the epididymis in the incision, select a point in the head which appears normal, and with scissors snip out a fragment about $\frac{1}{3}$ in. in length which has been caught up in fine-toothed forceps. Gently massage or squeeze the epididymis about the opening and take up the fluid exuded upon a glass (microscope) slide and have this examined immediately by a competent observer to determine whether spermatozoa are escaping from the epididymis at this point. Many active spermatozoa will usually be demonstrable. If this

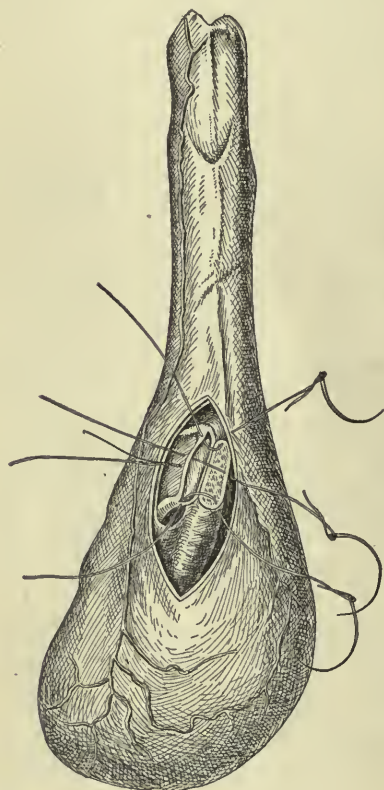


FIG. 2.—OPENED VAS SUTURED TO OPENING INTO HEAD OF EPIDIDY-
MIS. (Martin's operation.)

product of the testis is not found at this point, another site must be selected from which a fragment is removed and fluid obtained from this point examined in the same way. It may be necessary to remove the head of the epididymis from its attachment to the testis and search for spermatozoa from the orifices of the efferent tubules and attach the vas deferens to this point. With sutures of silk or fine silver wire in delicate curved needles, pass stitches from the outer to the inner surface of epididymis, then from the inner to the outer surface of the incision in the vas, placing one stitch at either end of the incision and one at each side. These sutures are all passed before being knotted down; they are then tied. The tunica vaginalis and the proper tunic of the cord are closed by buried catgut sutures, and the skin is approximated with silk or catgut. Apply dressing and snug suspensory or jock strap. The patient may be up and about on the following day.

The operation is practically without danger and its difficulties are not great.

Causes of Failure.—The causes of failure are:

- (1) Stenosis of the vas deferens.
- (2) Failure to find a point in epididymis or testis at which spermatozoa will be demonstrable.
- (3) Failure of anastomosis to remain patent by reason of scar formation.
- (4) Failure of sutures to hold.

Results.—A statistical statement of results is not available. Successful results have been obtained by many surgeons—Martin, Hagner, and others. Martin and Hagner report 6 successes in 9 operations.

EPIDIDYMECTOMY

Indications.—The separation of the epididymis from its testis and its removal with part of the vas deferens is advisable when a tuberculous focus is confined to the globus minor. By this procedure the advantage of retention of the testis for its internal secretion and for the mental effect upon the patient is gained. This operation is, as Leguen has said, “sufficient without being excessive” in contradistinction to orchidectomy for such involvement.

Double epididymectomy should be resorted to rather than castration. Since tuberculous of the epididymis, in a number of cases, if not in the majority, precedes the involvement of the seminal vesicles and prostate gland, and since the testis is very rarely involved except by extension from the epididymis, epididymectomy is the rational means of checking the progress of the disease in the genital tract.

The removal of the tuberculous focus by epididymectomy has been followed by the disappearance of or improvement in lesions also present in the testis, seminal vesicles and prostate (17) and may have a beneficial effect upon the general condition of the patient.

Keyes says: “Slight testicular involvement may be depended upon to heal spontaneously after removal of the epididymis.”

As opposed to orchidectomy, most American and French writers advise epididymectomy as the radical operation of choice unless the testis is acutely involved or seriously invaded by the destructive process.

The vas should not be removed beyond the external inguinal ring except in those rare cases of extensive involvement and severe pain which demand total vasectomy. Chronic indurated nodules in the epididymis may give rise to neuralgic pain and to recurrent acute or subacute epididymitis calling for the removal of the entire epididymis.

Gross involvement of the testis, epididymis, vas deferens, seminal vesicle, and prostate without discoverable lesions elsewhere in the body, or even with other involvement when the pain of the genital lesion is severe, will in rare instances justify the total removal of the testis, epididymis, vas and seminal vesicle, together with the corresponding lateral lobe of the prostate (17). Severely painful (bladder function especially disturbed) lesions or gross lesions of the seminal vesicle and prostate with epididymal involvement may be relieved by the removal of the epididymal lesion only.

Anesthesia.—General anesthesia.

Anatomic Points.—The vessels of the epididymis and testis enter and emerge from the inner aspect of the organs in the sulcus between the two. To separate these two organs, therefore, incision should be begun and dissection carried on from the outer aspect, cutting close to epididymis to avoid injury to the vessels of the testis.

Instruments.—The instruments required are as follows:

Scalpel.

Scissors.

Forceps: dissecting (2) and toothed (2).

Hemostatic forceps (6).

Fine curved needles.

Needle holder.

Catgut.

Silkworm-gut.

Method.—An incision about 5 cm. in length is made in the lateral aspect of the scrotum, exposing the tunica vaginalis. If a sinus exists or if there is adherence of the tissues about the epididymis to the skin, the incision should be made about this to include it in the tissue removed with the epididymis. A sinus should be thoroughly cauterized with pure carbolic acid or the actual cautery and its channel should be closed by clamp or packing to prevent the escape of infectious material before the first incision is made. After exposure of the tunica vaginalis, this should be dissected free from the scrotal tissues and delivered through the incision. Cover the incision with a towel or gauze and carry on further procedure with the testis lying upon this. Open the tunica vaginalis and turn the testis and epididymis out and make careful examination of the lesion present.

With the fingers of the left hand separate the epididymis from the testis, i. e. open the sulcus between the 2 on the outer side and incise with a scalpel through the tunica vaginalis and thin connective tissue underlying this. Now begin at the upper extremity (head) of the epididymis and, lifting it away from the testis, separate the connecting tissues by blunt dissection as far as possible but by careful snipping with scissors where necessary. By close inspection from the inner as well as the outer side of the epididymis of the tissue to be cut, the resulting injury to blood-vessels will be very slight. No important vessel will be divided and the arterial supply of the testis will be preserved.

The vas deferens should always be removed with the epididymis up to the external inguinal ring. It is easily separated by blunt dissection high in the cord, ligated, divided, and its stump cauterized. If it is thickened or nodular (beaded), it should be brought to the skin surface through a stab wound in the skin over the external inguinal ring and sutured here for drainage. During this procedure the testis should be gently handled—not squeezed in holding it—and the vessels of the cord should not be compressed or handled. The parietal layer of the tunica vaginalis may be drawn over the testis and sutured by 2 or 3 stitches of fine catgut to the cut epididymis. The testis is then replaced in the scrotal sac, a drain of folded rubber tissue is inserted to the bed of the epididymis, brought through the lower extremity of the skin incision, and held here by a catgut suture to the skin. The skin incision is closed by 2 or 3 interrupted sutures of silkworm-gut, and a light dressing applied. A snugly

fitting suspensory bandage is applied. The patient should be kept in bed for 2 or 3 days. The drain may usually be removed on the fifth day.

OPERATIONS UPON THE TUNICA VAGINALIS TESTIS

OPERATION FOR HYDROCELE

Acute hydrocele, which occurs with traumatism or inflammatory disease of the epididymis, subsides usually as the injury or disease subsides, requiring no operation. Occasionally, however, relief of pain may be obtained by tapping, i. e., by puncture with a hollow needle or small trocar and cannula. Chronic hydrocele may rarely be cured by simply withdrawing its contained fluid, but this is in most instances futile, for the fluid will usually again accumulate unless the secreting layer of serous membrane is destroyed. The destruction of this serous layer may be effected by (1) the application to its entire surface of deliquesced crystals of carbolic acid (95 per cent. carbolic acid) which is injected after all the serous fluid has been withdrawn, or (2) all of the parietal layer (i. e. all of the serous membrane except that covering the organ itself) may be everted. This (2) results in apposition of the serous surface with the connective tissue of the scrotal cavity and its destruction by adhesions. A serous sac is only possible where serous surfaces are apposed for fluid to be held between the non-adherent surfaces. The serous surface may be destroyed by (3) packing the cavity, which will cause replacement of the serous surface by granulation tissue, or, best of all (4), it may be removed.

EVACUATION OF THE FLUID BY HOLLOW NEEDLE OR CANNULA AND THE INJECTION OF CARBOLIC ACID

Injections of iodine and many other escharotics have been employed but have been abandoned, because of giving rise to severe pain or violent inflammatory reaction, in favor of the practically analgesic escharotic, carbolic acid. Thin-walled (translucent?) hydroceles of small or moderate size containing clear, serous fluid are best suited for this method.

Anesthesia.—No anesthetic is necessary. The injection of cocaine gives as much pain in its performance as does the puncture.

Procedure.—Hold the hydrocele firmly in the left hand, outlining and holding the testis if possible. With a medium-sized aspirating needle or small-sized trocar and cannula held firmly in the right hand, with the index finger placed upon the shaft of the needle and just as far from the point as the depth to which the needle is to be inserted, by a sudden thrust pass the needle through the skin of the scrotum at the junction of the middle and lower thirds of the tumor on the anterior aspect into the sac. Avoid striking and injuring the testis, epididymis, and cord. Allow the fluid to escape from the needle or

cannula after removal of the trocar. Some manipulation of the needle and kneading of the sac will be necessary to secure complete evacuation. Be careful that the needle point does not escape from the cavity, resulting not only in failure to evacuate its contents, but also in the injection of carbolic acid into the scrotal tissues instead of into the serous sac.

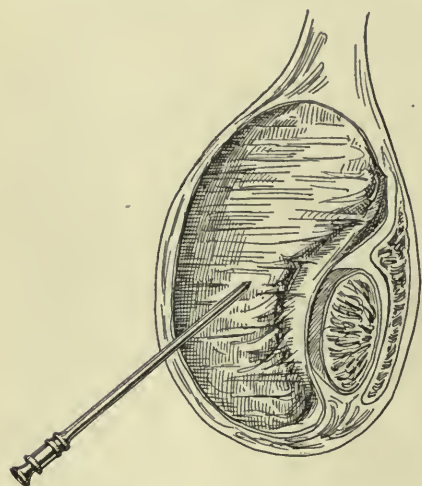


FIG. 3.—TROCER AND CANNULA INSERTED INTO HYDROCELE SAC.

Connect a syringe loaded with carbolic acid, 95 per cent., 2 c. c. (m xxx), to the needle or cannula, and inject this into the cavity, removing the instrument forthwith. Apply 95 per cent. alcohol to the puncture wound and the skin about this to prevent the burning with carbolic acid. Knead or massage the sac gently but thoroughly in an effort to distribute this small quantity of carbolic acid over the entire wall of sac.

This is essential for success—all the serous membrane must be destroyed by the carbolic acid or recurrence will supervene. This can be done gently and painlessly, but must be thorough. Apply a firm bandage, or strapping. To keep the patient in bed for a day or 2 is wise, although, with a snug suspensory

bandage or scrotal strapping, some cases may be permitted to be up and about without serious consequences.

Incision and packing of hydrocele, removing as much of the parietal wall as is readily accessible to the incision, are an old procedure discarded chiefly because of the failure of the packing to reach and destroy all of the serous coat. Recurrence is, therefore, frequent, and healing by granulation is tedious. It is not a satisfactory method compared with others.

EVERSION OF SAC: "BOTTLE OPERATION"

Incise the scrotum upon the upper anterior part of the tumor down to the tunica vaginalis. Dissect the entire sac from the outer tissues of the scrotum, bluntly as far as possible, but cutting with scissors when necessary. Incise the sac and turn it inside out, bringing the cut edges together by a few catgut sutures in this position. Do not constrict the cord. Be sure that, in replacement of this inverted sac within the cavity of the scrotum, no redundant rolling back of the serous coat can occur, for a ring-like sac, like a seat-ring, may form and enlarge after this procedure, from the rolling back of the edges all about. In many cases when this operation is performed it is, therefore, best to trim away much redundant sac wall before suturing the edges behind the testis and cord. Excision of the entire parietal wall of the sac is a preferable procedure.

EXCISION OF THE SAC

Anesthesia.—General anesthesia with gas and ether or gas and oxygen is employed. Some cases will bear this procedure under local infiltration anesthesia, but pain from occasional dragging on the cord is marked.

Procedure.—An incision, 5 cm. to 10 cm., is made in the outer anterior aspect of the scrotum, deepening through all layers till the sac is reached. A plane of cleavage or easy separation by blunt dissection may be found just outside the tunica vaginalis, and it expedites and facilitates the operation to do this so far as possible before opening the tense sac of fluid. Evacuate the fluid by incision

of the sac. Deliver the sac with the testis and cord through the incision in the scrotum and with scissors trim away all the parietal layer close up to the testis and epididymis. Care is required that no cut involves the edge of the epididymis



FIG. 5.—EVERTED SAC SUTURED BEHIND CORD AND EPIDIDYMIS.

and that no injury is done to the vessels of the cord. Do not permit the testis to be revolved upon the cord as torsion of the cord, with injury to the vessels, may result and, in replacing the testis in the scrotum this twist will persist, resulting in necrosis of the testis—not a rare accident.

Bleeding must be completely checked in the tissues of the scrotum by clamp and ligature and in the edges of the cut sac by ligature or by continuous suture before the serotum is closed. It is well to insert a thin rubber tissue drain from the lower extremity of the skin incision into the serotal sac to afford escape of serum or blood. A suture or 2 of fine catgut may be used to bring the deep layers of the scrotum together.

The skin incision is closed by 3 or 4 interrupted stitches of silkworm-gut or silk. One mattress suture may be used to control several bleeding points or

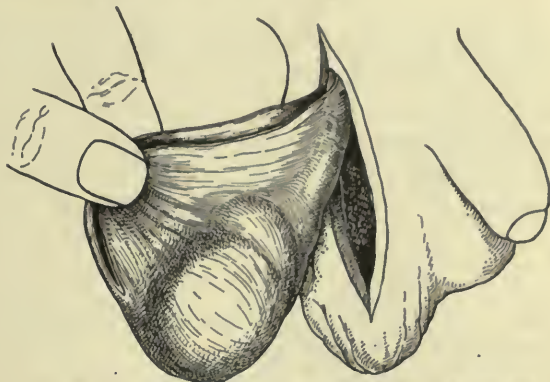


FIG. 4.—HYDROCELE SAC TURNED BACK READY FOR SUTURING.

oozing in the skin. A snug dressing with strapping to a bridge or a close-fitting suspensory is then applied and the patient is kept in bed for 3 to 7 days. The suspensory should be worn for 3 weeks.

OLD THICK-WALLED HYDROCELE

Excision of the tunica vaginalis prevents reaccumulation of the fluid and the thickening of the outer connective tissue layers will often subside in the course of time. Excision of much of this thickened tissue can often, however, be accomplished by the same procedure as removal of the inner sac. In fact, the only available line of cleavage may be found outside much of the thick, many-layered wall of the sac.

OPERATIONS UPON THE SCROTUM

RESECTION OF THE SCROTUM

Indications.—Resection of the scrotum is indicated for greatly enlarged scrotum which has contained a large hernia or hydrocele, varicocele, or diseased testis (neoplasm), and for disease of the scrotum, such as elephantiasis, filariasis, etc.

Anesthesia.—Local infiltration may be used. If extensive resection is contemplated, general anesthesia should be employed. Lumbar spinal anesthesia (tropacocain, etc.) readily produces complete loss of sensation in the skin of the scrotum.

Method.—Using a stomach clamp (special scrotal clamps have been devised) applied to the redundant lowermost portion after the testis and cord are securely protected by being held up within the upper part of the scrotum near the pubic bone, the excess of tissue beyond the clamp may be freely cut away with a knife or scissors and mattress or running suture applied so as to secure bleeding points (loosen clamps) and approximate edges.

After operation upon structures within the scrotum through an incision in its wall, a large flap may be excised from one or both sides of the incision. The scrotum may be split along the median raphé and as much as is deemed necessary may be removed lateral to this line, with suture again along the line of the raphé. With primary healing, this should leave a scarcely discernible scar. However, all scars in the scrotum tend to fade out rapidly. For epithelioma of the scrotum resection should be generously wide in normal tissue, always beginning the incision above and extending it down and outward to cut off in the first place, before further handling and dissection, the blood-vessel and lymph courses. Practically the entire scrotum, leaving but a fringe of a half inch or more, may be removed with confident expectation of reparation by growth and stretching to practically normal size and appearance.

OPERATIONS UPON THE SPERMATIC CORD

OPERATION FOR VARICOCELE

SUBCUTANEOUS LIGATION (KEYES)

Anesthesia.—Subcutaneous ligation may be carried out under general anesthesia or local anesthesia by infiltration of the tissues with novocain, cocain, $\frac{1}{2}$ per cent., etc.

Method.—The experienced hand must distinguish the different structures (veins and vas) through palpation of the cord and separate the vas with its vessels by the sense of touch from the bundle of enlarged veins. After such cleansing and sterilization of the skin as are carried out for open operation, the operator separates the vas deferens from the bundle of veins and holds the vas back between the thumb and fingers of the left hand. A Reverdin needle (provided with an eye which may be opened upon one side for threading), threaded with stout silk ("catgut not effectual"—Keyes), is passed through the skin of the scrotum just in front of the nail of the thumb so as to pass behind the bundle of veins through all the tissues of the scrotum and is brought out through the skin of the other side of the scrotum. One end of the silk ligature is drawn out free on this side so that the ligature then has 1 free end on each side. The silk ligature is then released from the eye of the needle and the needle is withdrawn until its point is to the inner side of the bundle of veins, without being withdrawn through the first puncture. The needle is then carried through the scrotal tissues in the same direction toward the puncture wound of the outer side of the scrotum but anterior to the bundle of veins, exercising care that the veins are not punctured by the needle in so doing, but keeping as close as is practicable to them, bringing the needle out precisely through the second skin puncture on the outer side, through which the silk ligature extends. The needle is now threaded with the free end of silk and needle and the silk is drawn back through the original puncture. A firm knot is tied and cut short. This knot should disappear within the original puncture and dimpling of the tissues at the point of opposite puncture should be avoided by sharply lifting the skin away, which tears away the bit of dartos caught in the ligature. Colodion or sterile dressing is applied to the punctures. The tying of the ligature about the cord is very painful and should be done under gas anesthesia. One ligature is said to suffice; Keyes at times applies 2 or even 3. Silk may

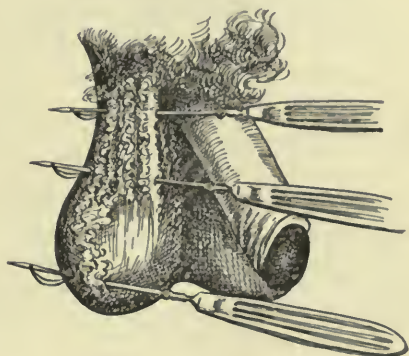


FIG. 6.—KEYES' SUBCUTANEOUS LIGATION FOR VARICOCELE.

remain harmless in the tissues or may act as a foreign body and ulcerate to the surface, necessitating removal.

(I regard this operation as obsolete.—EDITOR.)

OPEN OPERATION

Indications.—Open operation is indicated for varicocele when painful or causing atrophy of the testis.

Instruments.—The following instruments are needed:

Scalpel.

Scissors.

Two pairs of toothed forceps.

Artery clamps.

A pair of small skin retractors.

Ligature carrier.

Needle for skin suture.

Catgut No. 1 and No. 3.

Silkworm-gut or silk.

Anesthesia.—General anesthesia with gas and oxygen or gas and ether or local infiltration may be employed.

Method.—An incision, 2 to 4 cm. in length, is made in the upper anterior part of the scrotum through the loose tissues down to the cord. The cord is

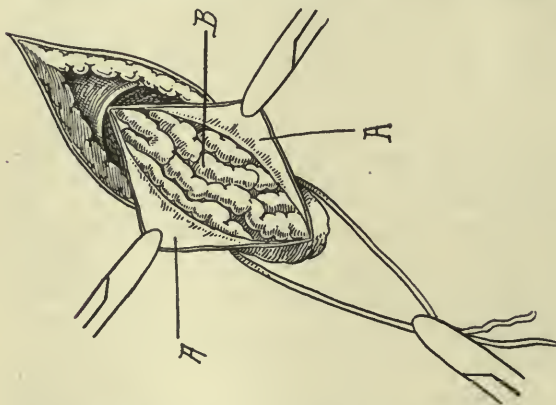


FIG. 7.—SHEATH OF CORD OPENED EXPOSING VEINS.

dissected free by gentle blunt dissection, hooked up with finger or ligature carrier, and drawn out of the incision. The connective tissue forming the capsule or sheath of the cord is carefully incised longitudinally, exposing the veins and other components. The vas deferens, with the loose tissue about it, is isolated so as to preserve the vessels passing with the vas and held apart. Heavy catgut (No. 3) is then passed about the bundle of veins and tied at the uppermost point available. A second ligature of the same sort is applied to the bundle of veins at a point 4 to 8 cm. below and securely tied. Excise the section of cord between ligatures by cutting through the ligated bundle of veins 1 cm. from the ligatures to insure against these slipping off. Do not tie the free ends of the ligatures together, as this tends to pull them off the stumps. Pass a suture of No. 2 catgut through the free stump of each end of the bundle of veins and tie this to serve as a support for the testis

in its elevated position by reason of this shortening of the cord to the extent of the excised portion. The connective-tissue sheath may also be shortened in suturing it with fine catgut. The entire extent of varicose veins may be excised by ligation close to the testis, removing all veins. This requires a little more time, with the ligation of several bundles of veins close to the testis and more dissection and traumatism of tissues, without appreciable advantage.

Dangers.—Failure of the ligatures to hold through slipping down over the stumps, i. e., too short stumps, and softening of the catgut and slipping of the knot before complete occlusion of the veins by thrombus formation, resulting in secondary hemorrhage and great difficulty in securing the veins, which may have retracted up into the inguinal canal or pelvic cavity or down into serotum, are accidents which may result in very extensive, even fatal, loss of blood and require a second operation under general anesthesia with free exposure for finding bleeding vessels. Injury to the vas may occur. Ligation of both arteries to the testis may result in necrosis.

Causes of Failure.—Failure of the ligatures to include or to hold all of the varicose veins, resulting in gradual enlargement of those not included, causes failure of the procedure.

Results.—The operation results almost uniformly in cure.

OPERATION FOR HYDROCELE OF THE CORD

Hydrocele of the cord is a frequent complication of hernia and of hydrocele of the tunica vaginalis. Expose the cord and the hydrocele by an incision in the skin over its course in the groin or upper serotum. It may be necessary to expose the inguinal canal by slitting the overlying aponeurosis of the external oblique muscle, with subsequent suture of this aponeurosis as in hernia operation. The entire sac is carefully excised and the skin sutured.

OPERATIONS UPON THE VAS DEFERENS IN THE COURSE OF THE CORD

VASOTOMY AND VASOSTOMY

Indications.—Vasotomy and vasostomy are indicated for injection of solution into the vas, ampulla, and seminal vesicle for the treatment of acute and chronic seminal vesiculitis.

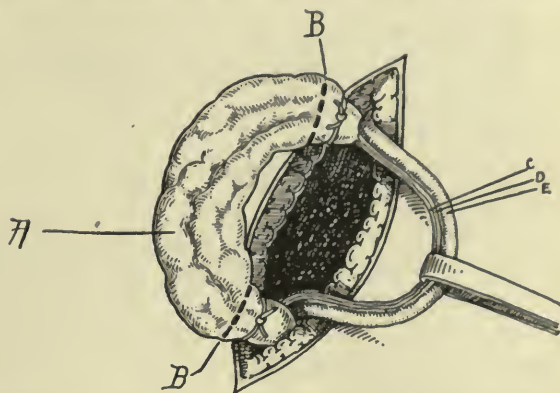


FIG. 8.—VAS AND ITS VESSELS SEPARATED FROM VEINS OF SPERMATIC CORD TO BE LIGATED AND EXCISED.

Instruments.—The instruments required are:

Scalpel.

Sharp-pointed tenotome.

Fine-toothed forceps (2 pairs).

Fine scissors.

Fine curved needles, conjunctiva needles.

Two round needles.

Fine silk or silver wire.

Blunted hypodermic needle.

Hypodermic syringe.

Method.—By palpation of the cord distinguish the vas deferens and bring it close to the surface of skin either in the posterolateral aspect of the scrotum or just below the external ring. Secure the vas in this position by a round needle (or 2 needles at different points 1 cm. apart) passed through the skin beneath the vas and out through the skin again. Do not injure the vessels of the cord or the vas in doing this. Incise the skin and coverings of the cord over the vas, retract the edges of the incision, and expose the vas, scrupulously avoiding injury to the vessels of the vas either in sharp or blunt dissection.

With fine eye (or manicure) scissors make a small transverse nick in the wall of the vas through one half (or less) of its circumference to open its lumen. With fine probe-pointed (eye) scissors passed into the lumen, make a small ($\frac{1}{2}$ cm.) incision through the wall of the vas in a longitudinal direction. Pass a fine, curved intestinal needle, threaded with fine silk or horsehair, into the lumen through the mucous surface and wall of the vas on each side of the incision and secure the upper suture to the upper edge of the skin incision, the lower one to the lower edge of the skin incision. Other sutures may be placed in the same fashion below to secure vasostomy. Pass a fine silver tube, or needle whose point has been removed and end smoothly rounded, into the lumen of the vas and through this tube or needle inject the solution intended for treatment of the seminal vesicle and vas. This vasotomy may be maintained as a vasostomy so long as needful.

PARTIAL EXCISION OF THE VAS

Excision of part of the vas has been recommended for the sterilization of habitual criminals, insane persons, and defectives. It may be performed under local anesthesia (infiltration) with the exposure of the vas as for vasotomy. Draw a loop of vas out through the skin incision and ligate at the upper and lower limits of the exposed portion (1 or 2 in. between ligatures) and excise this part. One or two sutures of silkworm-gut close the incision.

VASECTOMY

(Deferentectomy)

Indications.—The removal of the vas deferens in its entirety is indicated in tuberculous or chronic inflammatory disease of this duct and of its terminations at the testis (the epididymis and testis) and at the prostate (the ampulla of the vas and seminal vesicle). The operation is an extensive surgical procedure presenting technical difficulties and is to be undertaken only after careful weighing of the demand. Avulsion of the vas within the inguinal canal or in its pelvic portion is never to be practiced. If the diseased vas deferens is broken off in its pelvic course, the extremity should be sought and the total vas removed, or at least adequate drainage should be provided after exposing it. Keyes reports a case of death from pelvic abscess resulting from this injury.

Total vasectomy is, at all events, rarely indicated, since the prospect of cure by such radical procedure is not clear, for lesions in the prostate which cannot be totally eradicated and lesions elsewhere in the body are almost always present.

See also indications for Epididymectomy.

Anatomic Points.—Anatomical points to be noted are those mentioned in connection with operations upon the scrotum, testis, epididymis, and seminal vesicle, as well as the consideration of the course of the vas in the inguinal canal and pelvis. The diseased vas is often friable and weak so that traction upon it at all times, especially in the depth of a wound, must be gentle to avoid rupturing it. The vas is readily distinguishable from the other structures of the cord by palpation. It is of greater density and is usually found somewhat to the inner side of the greater portion of the vessels.

When thickened by disease, it may be as large or larger than the normal mass of the spermatic cord. Passing through the internal inguinal ring, it turns over the deep epigastric artery and, leaving the spermatic vessels, takes a downward course into the pelvis immediately beneath the peritoneum, which may be intimately adherent to the diseased duct throughout its course or at intervals along it. It crosses over the cord-like obliterated hypogastric artery and over the ureter, running, deep in the pelvis, nearly parallel with the ureter and to the inner or mesial side of it to dilate into the ampulla of the vas close to the median line beneath the floor of the bladder and to the mesial side of the seminal vesicle, whose outlet duct joins with it below to form the ejaculatory duct which enters the prostate at its base.

The removal of the entire vas deferens necessitates its dissection in the pelvic portion by means of an incision in the anterior abdominal wall. The removal of the seminal vesicle from above, i. e., through an abdominal incision, requires delicate and exact manipulations in the apex of a deep conical or wedge-shaped wound without the help of direct vision. Much of it must be done by sense of touch alone. The control of hemorrhage at this depth is difficult, and the

enucleation of the vesicle with its capsule or from within its capsule, without opening its lumen or grasping it in forceps, tries the technical skill of the most expert. To grasp in forceps the vesicle or vas deferens whose wall is diseased with tuberculous or chronic inflammation or neoplasm is well calculated to open this infectious material to the entire field, from which drainage will be very poor at the best. The accessibility of this lowermost extremity of the vas is usually much simpler by the perineal or perineo-ischiorectal route, where the parts are under control of sight, hemorrhage is more readily checked and drainage will be much more effective if infectious material does escape into the field. Furthermore, the other vesicle and vas are under observation in the perineal wound, which cannot be the case by the inguinal or lateral abdominal route (Villeneuve, Villard, Roux, Leguen).

The median abdominal route as employed by Young, with a T-shaped incision cutting the recti-abdominales muscles transversely at the umbilicus, is a major surgical mutilation which will but rarely be resorted to. For these reasons the removal of the vas should usually be a combination of the removal of the seminal vesicle and ampulla of the vas from below (perineal) with mobilization of this pelvic extremity of the vas, after which a comparatively slight injury of the anterior abdominal wall serves to give space for the dissection of the vas from the inguinal canal to its freed end beneath the bladder. Even if the vas should be found densely adherent throughout its course in the pelvis and free opening of the abdominal muscles be demanded, the procedure is greatly simplified when the vas has been divided previously from below.

Anesthesia.—General.

Instruments.—The following instruments are necessary:

Scalpel.

Scissors: Straight, curved, and long.

Forceps: Dissecting (2); toothed (2); long (2).

Hemostatic forceps (6); 2 or 3 long clamps.

Retractors: pair sharp; blunt deep.

Needles.

Needle holder.

Catgut.

Silkworm-gut.

Cautery or pure carbolic acid and alcohol.

Method.—With the patient in the exaggerated lithotomy position, by the perineal incision described under vesiculotomy, or the perineo-ischiorectal incision (Voelcker) for vesiculectomy, remove the seminal vesicle and ampulla of the vas and free the stump of the vas as high in the vesicorectal space as possible, exercising care neither to tear the vas by traction nor to rupture the overlying peritoneum if it be adherent.

Insert a drain of rubber tubing into the bed of the vesicle and vas. Now place the patient in the dorsal position. Make a skin incision from the upper part of the scrotum, crossing the spine of the pubis and passing outward and

upward about 3 cm. above and parallel with Poupart's ligament to a point just beyond the internal inguinal ring, exposing clearly the aponeurosis of the external oblique, which is slit upon a director passed just beneath it through the external ring in the inguinal canal and dissected back above and below as in inguinal hernia. The musculofibrous sheath of the cord is now incised longitudinally, and the vas exposed and freed from the other structures of the cord by careful blunt dissection. With the left index finger within the internal inguinal ring pushing up the peritoneum and protecting the deep epigastric artery, a vertical incision is made across the fibers of the internal oblique and transversalis muscles for 1 in., to be extended, according to need only, upward and inward along the outer border of the rectus abdominis as high as the level of the umbilicus (Villard, Lyon).

Deep abdominal retractors are inserted as needed in the upper outer angle and in the median side of the wound. With gentle traction upon the vas, it is dissected free from the peritoneum against which it lies and to which it may be adherent, downward into the depth of the pelvis until its lowermost extremity (stump) is freed and removed. By suitable retraction in the hands of an assistant the entire course of the duct and its dissection may be followed by the eye when this large incision is made. The deep epigastric vessels are held to the inner side by the retractor. In a number of cases it has been found easy (Ville-neuve) to dissect out the entire vas by sense of touch, without resorting to the vertical incision, which, of course, should be avoided if possible. The incision of Baudet and Duval, continuing parallel to Poupart's ligament beyond the internal ring to the level of the anterior superior spine of the ilium, through the fibers of the internal oblique and transversalis, does not afford as direct access to the depth of the pelvis and mutilates the abdominal wall equally as much.

The testicular extremity of the vas should now be inspected by delivery of the testis through the scrotal portion of the incision and the operation as described for epididymectomy or orchidectomy carried out, according to the character of the lesion present.

The closure of the wound should be made in layers with buried kangaroo tendon, and the internal ring and inguinal canal repaired as in a hernia operation.

The wide exposure obtainable by the median incision to the umbilicus where both recti are divided transversely (Young, Baltimore), with extraperitoneal retrovesical dissection of both vasa and both seminal vesicles, may in very rare instances be necessary where the perineal route is not available, as might be the case with extensive cicatricial tissue in the perineum and vesicorectal space and when both ducts and both vesicles are involved. This procedure is preferable to 2 lateral wounds of the abdominal wall of the Villard type but operation, in cases with such extensive involvement, will be contra-indicated, as a rule, upon many grounds.

OPERATIONS UPON THE SEMINAL VESICLES

Operative treatment of spermato cystitis should be resorted to only after non-operative treatment has failed to bring about a subsidence of the process and give desired relief.

VESICULOTOMY: SPERMATOCYSTOTOMY

Indications.—Incision and drainage of these organs are done for acute suppurative spermato cystitis, i. e. abscess of the seminal vesicle or ampulla of the vas; for acute or chronic spermato cystitis giving rise to recurrent urethritis and epididymitis; for acute or chronic spermato cystitis with arthritis (rheumatism) when the vesicle lesion is regarded as the focus from which the systemic infection arises.

Anatomic Points.—Lying above the prostate between the bladder floor and anterior wall of the rectum in the lowermost part of the pelvic cavity, drainage of the vesicles or ampullæ of the vasa deferentia, to be satisfactory, must be downward toward the perineum, so that the approach to them for the purpose of affording this is through the perineum. Puncture, aspiration or incision of the seminal vesicles through the anterior wall of the rectum is a procedure not advocated in modern surgical practice. Access to the seminal vesicles through the abdominal wall is not adapted for incision and drainage. Exposure of the vesicle is obtained by the method for exposing the prostate through the perineum, as lucidly described by Proust and by Young for prostatectomy, and then continuing the separation of the tissues between the bladder floor and the rectum beyond the base of the prostate.

The rectal surface of the prostate is covered by the pelvic fascia (Desnonvillier) composed of 2 often separable layers. Beyond the base of the prostate, this fascia covers the dorsal (rectal) surface of the seminal vesicles and ampullæ of the vasa deferentia, forming the posterior portion of their capsule. This fascia (the anterior layer of it) folds over the upper extremities of the seminal vesicles and, extending down upon their anterior surfaces, is quite closely adherent to the bladder floor. Thus the vesicles are inclosed anteriorly, posteriorly, and above, within fascia which forms their capsules. Laterally the anterior and posterior leaves of fascia do not fuse about the seminal vesicle, but the capsule here is open to transmit the blood-vessels. The chief blood supply enters at the outer margin of the upper pole, where ligation will control practically all hemorrhage. Large veins from the periprostatic (vesicoprostatic) plexus course along the outer margins of each vesicle and frequently veins from the prostate stretch across the inferior surface of vasa and vesicles.

Dorsal to the fascia of the upper third of the vesicles lies the peritoneum of the vesicorectal fold (pouch of Douglas) which may be intimately adherent in inflammatory conditions. Commonly this peritoneum may readily be pushed away from the vesicles, for if the fascia covering their posterior surface can be

dissected free, the peritoneum goes with it. The ureter passes anterior to each seminal vesicle for nearly the upper half of its extent. It may even cross obliquely anterior to the seminal vesicle and enter the bladder wall in front of the ampulla of the vas. Operation upon these organs should, therefore, be done with as free exposure as possible and under direct observation, for, otherwise, injury to the closely related peritoneum and ureter may readily result.

The chief difficulties encountered in operation upon the seminal vesicles are the depth and narrowness of the perineal wound, the danger of injury to the bladder, rectum, peritoneum and ureter, and hemorrhage from large venous channels encountered in this region below the bladder and in front of the rectum. The recent suggestion of Squier (New York) to place silk sutures through the upper, outer angles of the prostate and the bladder wall for traction produces by far the best exposure of the vesicles and renders them accessible to examination and manipulation as no other means will do.

Young (Baltimore) employs a metal instrument through the urethra in the bladder, which depresses the floor of the bladder above the vesicle by contact with the inferior margin of the symphysis pubis as a fulcrum.

Anesthesia.—General.

Instruments.—The instruments required are as follows:

Scalpel.

Scissors, straight and curved.

Dissecting forceps: Plain (2); toothed (2).

Grooved director.

Artery forceps (6).

Rectal retractor (Young's for prostatectomy).

Deep broad and flat retractor.

Narrow blunt retractors.

Full curved round needles.

Surgical needles.

Needle holder.

Stout silk.

Catgut.

Silkworm-gut.

Rubber tubing for drainage.

Catheter or perineal tube for bladder drainage.

Grooved sound for external urethrotomy.

Perineal Method.—With the patient in the extreme lithotomy position, incision is made in the median line of the perineum from the perineoserotol junction above to within 1 in. of the anus below. From this lower extremity, 2 lateral arms of incision are made downward and outward to a point on each side halfway between the anus and the tuberosity of the ischium. This forms an inverted Y incision which is best suited for free exposure. By extension of the

lateral limbs of the incision in the ischio-rectal fossæ, the rectum may be mobilized to give all the advantages gained by the incision proposed by Roux and Voelcker. Expose the median tendon of the perineum and, by blunt dissection with the fingers, free the space on each side of it between the bulb of the urethra and transversus perinei muscles in front and the rectum behind up to the prostate. Divide the median perineal tendon, exposing the muscular band between the rectum and bulb of the urethra (recto-urethralis muscle) and divide this transversely. By blunt dissection of the space now opened, the prostate is readily exposed in the depth of the wound covered by the levator ani fibers, which are separated to each side of the median line and held back

against the bony pelvic walls by lateral retractors. Blunt dissection continued above the prostate separates the fascia covering the vesicles in front from the anterior wall of the rectum behind.

A volsella may now be placed upon the prostate at its upper border in the median line, by which it is drawn down into the wound, or the membranous urethra may be opened by a small longitudinal incision in its floor upon a grooved sound, and through this urethrotomy a tractor (Young's prostate tractor) may be passed into the bladder, opened and used to draw the prostate down. At this point it is well to insert posteriorly a broad flat retractor, which is long enough to reach well up to the vesicles, to hold down the bulging rectal wall and protect it from injury. "Two stout silk sutures are now introduced through the prostate and bladder wall at the junction of the prostate and bladder base at the uppermost point of the lateral

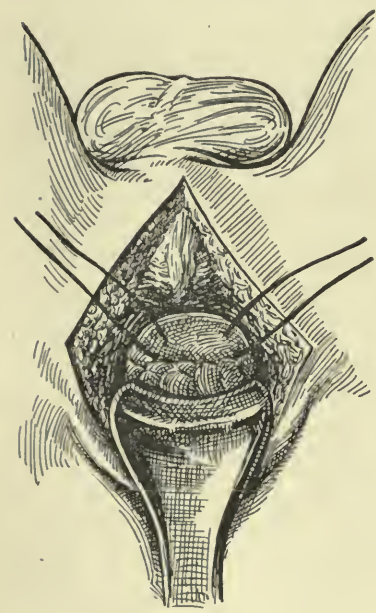


FIG. 9.—SQUIER'S TRACTION SUTURES IN PROSTATE.

margin of the prostate. They are placed as far laterally as possible. Traction upon these sutures downward and forward rotates prostate and bladder base upward and forward, thus exposing the fascia covering the vesicles" (Squier). The fascia may be divided longitudinally over the vesicles, exposing them, or it may be cut transversely just over the base of the prostate and dissected up and back away from the vesicles, giving free access to the vesicles over their entire extent.

Incision, with multiple puncture of distended sacculations, is now made and drainage is effected by suturing rubber tubing to the wall of the vesicle and some overlying fascia with catgut. Drainage tubes are easily displaced when the traction sutures are released and when the patient is restored to the normal dorsal position, as well as by the movements of the bladder and

rectal walls so that it is essential to secure the drainage tubes in place by stitching. After restoring the prostate to its normal position by removal of the traction sutures, the levator ani muscles should be brought together again along the median line posterior to the drainage tubes by 1 or 2 stitches of catgut.

Voluntary urination is sometimes difficult for a day or 2 after this operation, so that it is well to provide for bladder drainage by the insertion of a retained catheter through the urethra or of a catheter through a small longitudinal slit in the membranous urethra, which is visible and accessible below the apex of the prostate. The drainage tubes from the vesicle or vesicles and from the bladder are brought out through the perineal skin incision in the median line, or to one side, and the skin is approximated by interrupted stitches of silkworm-gut. Drainage must be maintained for about 2 weeks.

Fuller's Method.—The method of vesiculotomy of Fuller is as follows: The patient, under general anesthesia, is held by assistants in the knee-chest position. Incisions are made through the skin and subcutaneous fat in 2 converging lines beginning at the level of the base of the coccyx on each side and extending down and inward between the anus and the tuberosity of the ischium to points about 3 cm. anterior and external to the anus on the corresponding sides, and a transverse incision across the median line of the perineum joins these 2 in front of the anus.

With the first finger of the left hand in the rectum to act as guide and guard, the scalpel is used to dissect through the tissues between the anus and urethra until the median tendon of the perineum and the recto-urethralis muscle have been divided, so that a finger of the right hand may continue the separation of areolar tissue up to and beyond the prostate. This finger, with that of the left hand in the rectum, guides one to the seminal vesicles, which are unseen but palpable. Dissection is continued to separate the rectum from the fascia covering the vesicles, and a grooved director is inserted into the upper extremity of the vesicle, palpated and the scalpel is passed along the groove of the director so as to cut down upon the vesicle away from the rectum. By repeated examination (palpation) with the finger in the wound, the vesicle is incised throughout its extent. Its cavity is sometimes curetted. The same procedure is then carried

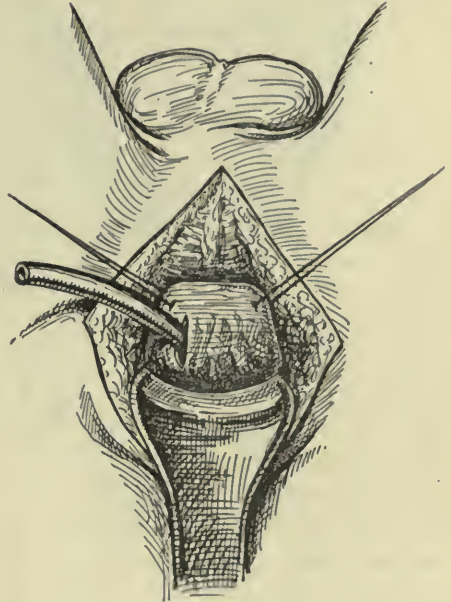


FIG. 10.—DRAINAGE TUBE IN RIGHT SEMINAL VESICLE. (SQUIER.)

out upon the other vesicle. Drainage is accomplished by means of rubber tubing inserted into each opened vesicle and retained in place for 10 to 14 days.

The incisions in the ischio-rectal tissues are closed by interrupted silkworm-gut sutures, while the transverse perineal cut gives egress to the drainage.

This operation fails to expose the vesicle to sight, the incisions into it are made entirely by sense of touch, and, therefore, it is not advocated for the examination of the organs for the study of their pathology and bacteriology. It presents dangers of wounding the ureter, which cannot be felt, and the bladder and rectum. The ureter especially is liable to injury, even at the hands of the most expert and cautious.

Results.—Fuller (8) reports 346 cases (1 death) with relief in practically all cases and cure of severe, often long-standing, rheu-

matic manifestations in many. Squier (15) reports favorable results in acute and chronic spermato cystitis and in selected cases of rheumatic affections.

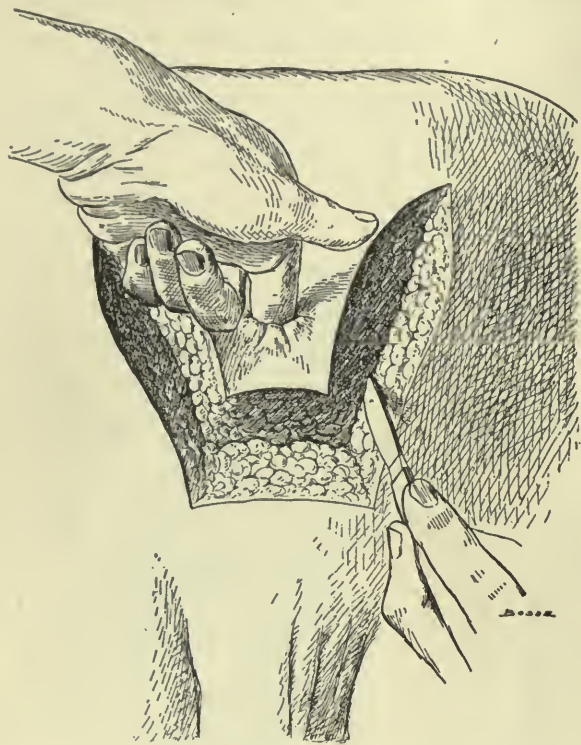


FIG. 11.—FULLER'S OPERATION. Skin incision. Patient in knee-chest position.

VESICULECTOMY: SPERMATOCYSTECTOMY

Indications.—Vesiculectomy is indicated in neoplasm of the seminal vesicle; tuberculosis of the seminal vesicle; chronic seminal vesiculitis.

The difficulties and dangers mentioned in connection with simple exposure and incision of the seminal vesicle are enhanced in its removal, especially when chronic perivesicular inflammation exists.

Anatomic Points.—Anatomic points to be especially noted are the important related structures which may be adherent or involved in the pathologic process of the vesicle and their inaccessibility by one or the other method of approach. Lesions which necessitate the removal of the vesicle are, with rare exceptions only, involvements of the corresponding vas deferens and its ampulla. (See Vasectomy.) The vesicle may be adherent to the peritoneum, requiring ex-

cision of tissue opening into the peritoneal cavity. This may be readily closed in some instances, while in others it may present great difficulty and subject the peritoneum to infection. The peritoneum is liable to injury both in perineal and abdominal operations. The ureter also is in danger, whether it be in the depths of the abdominal or the perineal wound. The bladder and rectum may be intimately bound to the vesicle so that the dissection must be carried out with great care. This may present considerable difficulty in the very narrow space obtainable by any approach. Bleeding vessels in the depth of these wounds have been found difficult or impossible to see and to ligate, so that packing was necessitated.

Anesthesia.—General.

Instruments.—As for vesiculotomy.

Perineal Method.—The patient is placed in the high or exaggerated lithotomy position. (Voelcker advocates the prone position with the thighs hanging over end of table which is elevated.) The seminal vesicle is exposed by the perineal incision, as described under vesiculotomy. Much more extensive exposure may be obtained by extending 1 lateral arm of the incision into the corresponding ischiorectal space about the anus, even as far as the side of the coccyx, so as to carry out the exposure recommended by Voelcker, which consists in mobilizing the coccyx by separation of the sacrococcygeal articulation or complete removal of the coccyx, cutting the lowermost fibers of the gluteus maximus muscle, and division of the sacro-ischiatic ligament and the fibers of the levator ani muscle. This gives exposure approaching that obtained by resection of the sacrum and permits adequate displacement of the rectum.

Insert traction sutures through the angle of the prostate with a bite in the bladder wall adjoining. After division or dissection of the pelvic fascia (fibrous capsule of the vesicle) covering the vesicle so as to expose its upper extremity, free it by blunt dissection, if possible, or by cutting with scissors or knife very cautiously, especially upon the outer margin where the vessels are encountered. Here is where the ureter may be encountered upon the bladder side of the vesicle and care must be exercised to avoid injury to it. Grasping the vesicle in forceps or clamp will crush and tear it, permitting the escape of its infectious contents. Vessels should be exposed, caught in hemostatic forceps, cut and ligated.

Drawing the vesicle downward and forward, it is separated from its bed down to the apex at the upper margin (base) of the prostate, where it meets the ampulla of the vas to form the ejaculatory duct. Close to the prostate, the vesicle is caught in a clamp and amputated. Its stump is cauterized with actual cautery or pure carbolic acid. The ampulla of the vas may now be dissected free above the base of the prostate, lifted up and dissected from its bed up along the duct until as much as possible is rendered mobile. In case of tuberculosis especially, as well as in other chronic inflammations of the vas deferens, traction must be exerted upon it with great caution, for it will tear and break at its weakest point, which may be in an area of active inflammation. The vas, when

freed by dissection, is caught in a clamp and divided, its stump is cauterized, and the ampulla removed. The removal of the vas is described under vasectomy. Drainage from the bed of the vesicle should be employed if infectious material has escaped during the operation or is present in the stumps. Drainage tubes must be sutured to fascia about the site to be drained to secure them.

Results.—Voelcker reports collected cases of vesiculectomy for tuberculosis to the number of 81 as follows:

Inguinal or abdominal incisions.....	15 cases, 3 deaths
Perineal or ischiorectal incisions.....	50 cases, 3 deaths
Resection of sacrum.....	16 cases, 1 death

About 50 per cent. of these cases presented urinary fistulae of short duration after operation; 80 per cent. of results were good.

Vesiculectomy for chronic gonorrheal and other inflammation, for cysts, calculi, neoplasm, etc., has been performed with good results in a small number of cases (16).

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CHAPTER II

OPERATIONS UPON THE PENIS AND OPERATIONS FOR CONGENITAL DEFECTS OF THE PENIS, URETHRA, TESTES AND URINARY BLADDER, INCLUDING TRANSPLANTATION OF THE URETERS

ALFRED T. OSGOOD

OPERATION FOR PARAPHIMOSIS

Operative relief is to be obtained if the application of warm wet dressings, compression by a snugly applied bandage and efforts at reduction have failed.

Reduction.—Reduction of a paraphimosis consists in compressing the glans penis and pressing it back through the constricting ring made by the tight retracted foreskin. Holding the swollen prepuce behind the plane of the constriction between the first and second fingers of each hand, draw the swollen ring forward while pressing with the 2 thumbs upon the glans so as to replace the glans penis within the preputial sac. Apply a wet dressing and maintain the organ in the upright position by a ring dressing attached to a waist band. Keep the patient on his back.

Operation.—Local infiltration anesthesia (1 per cent. novocain) may be used, although the parts may be analgesic as a result of the constriction and edema. When reduction is impossible and ulceration, necrosis and gangrene threaten by reason of the constriction obstructing the circulation in the glans penis and prepuce beyond it, the ring of constriction should be exposed by grasping the glans with the thumb and first finger of the left hand, exerting traction upon the shaft of the penis and bowing it forward over the back of the fingers of this hand. A curved bistoury or the narrow blade of a scalpel is then thrust through the prepuce behind the corona beneath the ring, with the edge upward and the back gliding back upon the sheath of the corpus cavernosum to either side of the median line, so as to

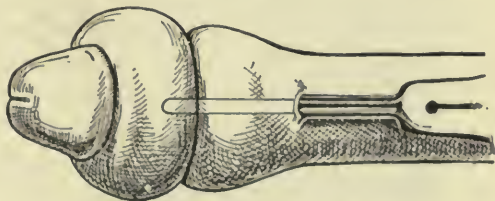


FIG. 1.—PARAPHIMOSIS. Grooved director inserted beneath constriction for division.

avoid injury to a dorsal artery or the dorsal vein of the penis. A grooved director may be inserted beneath the skin, through a small slit cut upon one side of the median line of the dorsum of the penis above the constriction and thrust downward beneath the constricting band. Infiltration anesthesia (novocain, cocain) is necessary for this. Upon this grooved director a narrow-bladed knife or tenotome may be passed on its side and turned upward beneath the ring to divide it and then withdrawn on its side. These 2 maneuvers provide for cutting from beneath the ring upward through the tissues, but it is often practicable to cut with a scalpel downward through all the edematous tissue and through the constricting band if care is exercised that the incision shall not extend into the dense fibrous sheath of the corpus cavernosum, shall not wound the corona glandis and shall avoid an artery or the dorsal vein. After release of the constriction, the part should be enveloped in wet dressings and held in the upright position by a suitable encircling pad. The bleeding resulting from the above incision seldom requires hemostasis by artery forceps and ligature.

DORSAL SLIT OF THE PREPUCE

Indications.—In young children this simple procedure may suffice for the relief of phimosis if the prepuce is not markedly redundant. It is also indicated for the exposure and treatment of subpreputial ulcerations, inflammations, or retained secretions and for the relief of preputial adhesions to the surface of the glans penis.

Anesthesia.—Local infiltration anesthesia with 1 per cent. novocain or $\frac{1}{2}$ per cent. cocain usually suffices except in cases of severe inflammatory conditions, when a general anesthesia with nitrous oxid gas, or gas and oxygen or gas and ether is preferable.

Instruments.—The instruments required are as follows:

Grooved director.

Knife, narrow blade.

Scissors.

Artery forceps.

Needle holder.

Needles.

Catgut and silk.

Method.—Infiltration with 1 per cent. novocain solution in the median line of the dorsal surface of the prepuce is made with an hypodermic needle and syringe. This infiltration must be made into the skin of the prepuce and also just beneath the mucous surface when the prepuce is redundant. The grooved director is then inserted through the preputial orifice upon the surface of the glans penis back to the coronal sulcus with the grooved surface of the director in apposition with the mucous surface of the prepuce which has been infiltrated. Care must be taken in every case that the director or cutting in-

strument shall not enter the urethra. A narrow-bladed knife or blade of sharp seissors is then passed in the groove of the director and the prepuce cut through. The mucous surface must be divided well back to the level of the corona. It is rarely necessary to control bleeding points by artery forceps and ligature. Two or more sutures of catgut or silk may be used to approximate laterally the edges of this longitudinal cut.

TWO LATERAL SLITS OF THE PREPUCE

Better exposure of unhealthy conditions beneath the prepuce is obtained by carrying out the above-described procedure upon each lateral aspect of the prepuce instead of with the median dorsal incision. The resultant flaps must be removed as in circumcision to produce a desirable cosmetic effect. This may be done at once or later, according to the conditions. In the presence of chancreoid or acute inflammatory conditions, the less exposure of tissue to extension of infection the better.

CIRCUMCISION

Indications.—Circumcision is indicated for the relief of an abnormally small preputial orifice or a long and voluminous prepuce and the consequent restriction of the stream of urine, the collection of urine, smegma, etc., and the irritations and inflammation (balanoposthitis) that may supervene from this uncleanness of the subpreputial space. This operation has been advised as a prophylactic measure against venereal infection, for the relief of verruca preputialis and of recurrent herpes preputialis.

Anatomic Points.—The chief anatomical point to be noted in performing this operation is that the skin of the penis is a loose, distensible sheath beneath which extravasation of blood from uncontrolled bleeding points may occur to produce an hematoma of large proportions. This same laxity and looseness make careful calculation necessary to determine the amount of prepuce to be removed so that upon its completion neither too little tissue has been removed, so that the glans is still covered when the organ is flaccid and contracted, nor too much has been removed, so that in erection and distention there is painful tautness of this sheath. One error or the other is occasionally made.

Anesthesia.—Local infiltration anesthesia (1 per cent. novocain) is employed, but general anesthesia is usually necessary for children. Infiltration must be made in lines of incisions to be made both into the skin and beneath the mucous layer of the prepuce. Novocain solution 4 per cent. must be held in the preputial cavity or applied within the cavity on a pledget of cotton for 5 minutes.

Instruments.—The following instruments are required:

Scalpel.

Straight scissors.

Director, grooved.

Artery forceps (3).

Toothed dissecting forceps.

Needle holder.

Surgical needles.

Catgut No. 0.

Silk or silkworm-gut.

Phimosis clamp.

Methods of Operation.—The entire penis and the preputial cavity should be thoroughly washed with soap and water and a non-irritating antiseptic fluid. Alcohol may be used if a general anesthetic has been given.

Note carefully the position of the corona glandis beneath the skin of the prepuce while the organ is flaccid and contracted and then grasp the glans and exert strong traction upon it, noting the position of the corona glandis again with relation to the skin of the shaft of the penis and prepuce when the organ is thus stretched. By this means an estimate of the extent of prepuce to be removed may be gained.

Grasp the margin of the prepuce at the junction of the skin and mucous surface in the median line of the dorsum (the position of the external meatus and dorsal vein of the penis should serve as guides) in an artery forceps and stretch out the prepuce by traction. Again note the position of the corona glandis beneath the skin of the prepuce in both the relaxed condition and when the glans is grasped and the entire penis is stretched by traction and mark the position of the incision in the skin by a nick in the dorsum with scissors or scalpel. This point should be just anterior to the corona when the penis is moderately stretched by traction. Grasp this point in an artery forceps to fix the median line for suture later. From this marked point upon the skin, outline by scalpel the course of the incision downward on each side parallel with the corona and make these incisions meet in the median line of the inferior surface, just posterior to the frenum. Pass a grooved director beneath the prepuce and sweep it over the surface of the glans to free adhesions, if possible, and then incise the prepuce with scissors or scalpel in the median line of the dorsum upon the grooved director to the point marked upon the skin where the artery forceps mark the median line.

Cut away the skin from the median line outward in the line marked by the incision previously made in the skin and trim away the redundant mucous membrane, leaving a cuff $\frac{1}{4}$ in. broad attached to the posterior aspect of the corona. Pass 4 sutures of non-absorbable material (silk or silkworm-gut) uniting the cut skin margin to the cuff of mucous membrane, 1 in the median line of the dorsum, 1 in the median line of the inferior surface at the frenum, and 1 each side half way between these. A few additional sutures of fine

catgut will approximate the margins all about. Hemorrhage should be carefully controlled, as each bleeding point appears, by hemostatic forceps and ligatures of No. 0 catgut. A band of folded sterile gauze is applied over the suture line and may be retained in place by leaving the ends of the 4 non-absorbable sutures long enough to tie over the gauze; or strips of zinc-oxid adhesive plaster may be applied over this gauze dressing. Dressings should be not too snugly applied. The penis should be held upright in a ring or dressing attached to a waist band. The above method gives a well-formed line of scar and avoids irregularities that sometimes produce poor cosmetic results.

The method of operation by applying a phimosis clamp is rapid and quite satisfactory. Special phimosis clamps are made straight and curved but clamp forceps of sufficient length which do not crush the tissues and yet hold the prepuce may be used. Grasping the median line of the orifice of the prepuce on the dorsum with forceps and the median line at the frenum in a second forceps, the clamp is adjusted parallel with the line of the corona so as to hold distal to it that part of the skin of the prepuce to be removed. By the cut of a knife along the distal surface of the clamp, the skin of the prepuce is amputated. Beware lest the clamp grasp the tip of the glans. After applying it be sure that the glans is free behind it within the preputial pouch. The mucous layer of the prepuce should then be trimmed away with scissors leaving a cuff $\frac{1}{4}$ in. broad attached to the corona. Hemostasis should be complete before suturing. Suture as in preceding method.

Allis' operation is very satisfactory. Make a circular incision about the preputial orifice. From the median line at the frenum, make 2 incisions in the skin, beginning at the edge of this circular incision and running down and out from the median line on each side, following the course of the corona and meeting in the median line of the dorsum just in front of the corona. Dissect the skin from the inner layer of the prepuce between the first circular incision at the preputial margin and the line formed by the meeting of the incisions on the dorsum. If this dissection is carefully carried out so as to remove skin only, leaving subcutaneous tissue undisturbed, most of the lymphatics and blood-vessels are preserved and hemorrhage and subsequent edema are practically nil (compare operation described by Dr. Klotz, 21). The length of time required for this careful dissection of the skin from its underlying areolar tissue, however, outweighs the advantages gained. Divide the



FIG. 2.



FIG. 3.



FIG. 4.

FIGS. 2-4.—CIRCUMCISION.

mucoas membrane of the prepuce in the median line at the frenum from the circular incision to the apex of skin triangle on the inferior surface, turn

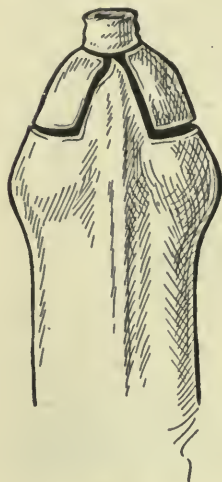


FIG. 5.

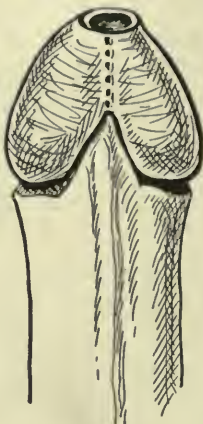


FIG. 6.

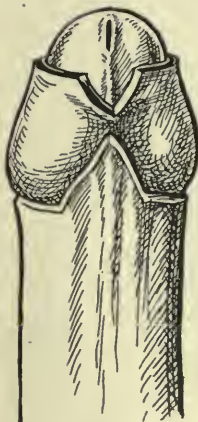


FIG. 7.

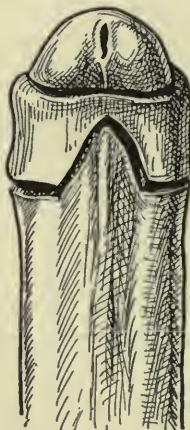


FIG. 8.

FIGS. 5-8.—ALLIS' OPERATION. Circumcision.

back the mucous membrane like a cuff, and suture its margin to the margin of the skin.

In infants a dorsal slit, no suturing and a simple aseptic powder as a dressing are sometimes all that is required. The part should, however, be frequently washed with sterile salt solution, dried with sterile gauze and powdered with boracic acid or aristol powder. In older patients, erections frequently disturb the patient with pain and may tear apart the suture line and result in considerable hemorrhage. Strong non-absorbable suture material should, therefore, be used for 4 or more interrupted stitches. To prevent soiling of dressings by urine, various devices have been employed, but urine is likely to find its way under some loose margin of a waterproof material and thus remain to decompose and irritate and perhaps infect the wound

which is kept moist beneath this impervious material. Zinc-oxid adhesive plaster applied over the dressing at the frenum and made to adhere to the glans below the external meatus of the urethra and waterproofed by 2 or 3 coatings of collodion will usually prevent wetting the dressings in boys or men who are intelligent enough to exercise care when urinating for 3 or 4 days after the operation.

If dressings become soiled, they should be changed daily or oftener to insure cleanliness. Rubber tissue with a slit large enough to admit most of the glans may be made to adhere to the glans by painting along its margin with a little chloroform with a camel's-hair brush and then painting over the margin with collodion. This must be done while the anesthetic is in

effect. Behind this rubber tissue dressing, the wound may often be kept unsoiled until healing is secured. Sutures should be left in place for 5 to 7 days. Rest in the recumbent position for 2 or 3 days certainly hastens healing and diminishes the tendency to edema. Many ambulatory cases, however, give excellent results.

AMPUTATION OF THE PENIS

Indications.—Amputation of the penis is indicated in cancerous growth (epithelioma) of the glans penis or distal extremity of the urethra without involvement of the shaft of the organ or of lymphatic nodes in the groin. Excision of a part or the whole of the tumor or ulceration, under local infiltration anesthesia, for microscopic examination is a necessary preliminary procedure and is done under general aseptic surgical precautions. Occasionally crushing wounds of the distal portion of the penis or gangrene of the organ may require amputation, although patient surgical care and healing by granulation will usually result in less loss of tissue than surgical removal.

Amputation is contra-indicated in phagedenic and in chancreoid ulceration for the reason that the subcutaneous lymphatics and areolar tissue of the shaft of the organ are filled with the infectious material from these ulcerations and the stump soon after operation will present again all the features of the original lesion. Amputation is never necessary for extensive benign epithelial overgrowth (warts), which often closely resembles clinically malignant disease. This cauliflower growth can be eradicated by trimming these growths to their bases with scissors and thorough searing of the whole denuded surface with the dull red cautery, or they may be destroyed by the high-frequency (Oudin) spark.

To amputate an epitheliomatous distal extremity of the penis and to dissect out the inguinal lymph nodes, while leaving cancerous tissue in the parts intervening between these fields of operation, is not wise except for temporary palliative relief. It is not radical removal. For radical removal of cancerous disease extirpation of the penis with the adjacent lymph nodes is necessary.

Anesthesia.—General anesthesia, spinal anesthesia.

Instruments.—The instruments to be employed are as follows:

Scalpel.

Scissors.

Dissecting forceps (2) and toothed forceps (2).

Metal sound.

Hemostatic forceps (6).

Catgut; chromic gut; silk or silkworm-gut.

Needles.

Needle holder.

Rubber band (catheter) for tourniquet.

Method.—If the growth is ulcerating, paint the surface with pure carbolic acid followed by alcohol and cover it with gauze, held in place by a snug bandage, to prevent soiling any part of the operative field, hands or instruments by its secretion. Make traction upon the penis and apply a tourniquet (catheter) about the base of the organ close to the scrotum. The circular

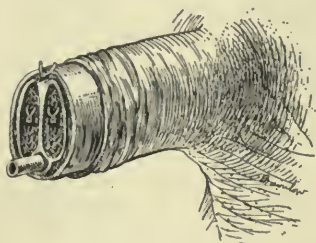


FIG. 9.

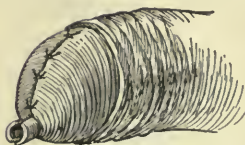


FIG. 10.



FIG. 11.

FIGS. 9-11.—AMPUTATION OF PENIS. Circular incision.

flap operation is more rapidly performed and gives as satisfactory a result as that which provides one anterior and one posterior flap. Insert a metal sound into the urethra to define the corpus spongiosum. Draw the glans penis forward and make a circular incision through the skin around the organ at the desired distance from the diseased tissue, dividing the tissue down to the fibrous sheath of the corpora cavernosa. Dissect the skin flap back for about 2 cm. and divide the cavernous bodies transversely down to the corpus spongiosum. The 2 dorsal arteries and the dorsal vein are now identified, caught in artery forceps, and ligated and the artery in the center of each corpus cavernosum is controlled in the same way. Carefully dissect the corpus spongiosum from the inferior surface of the sheath of the cavernous bodies to a point 1 cm. distal to the division of the corpora cavernosa, remove the sound, and then divide the spongy body and urethra transversely. Now remove the tourniquet and apply pressure with gauze upon the stump, which controls the bleeding promptly. Pass 2 or 3 sutures of slowly absorbable material (chromic gut) laterally through the fibrous sheaths of the corpora cavernosa and the median fibrous septum and tie over the stump.

Split the urethral wall upon its roof and its floor for about $1\frac{1}{2}$ cm. Draw the skin forward and suture it below about the urethra with 4 or 5 interrupted stitches of silk, accurately adapting the median line of the inferior skin surface to the median line of the floor of the urethra. Slit the skin of the dorsum for a short distance and unite its edges laterally by interrupted silk sutures down to the urethra. Insert a soft rubber catheter through the urethra into the bladder and retain this in place till healing of the suture lines is well advanced. Apply a small, well-fitting sterile dressing and secure the catheter to the outer surface of this by strips of adhesive plaster.

Flap Method.—A long flap is made of the skin and subcutaneous tissue of the dorsum and a shorter flap of these tissues of the inferior surface. Pass a straight metal sound or bougie into the urethra. Apply a tourniquet about the base of the penis and draw it out to full extension. Make an incision through the skin and underlying tissues on the lateral aspect along the long axis of the penis over the inferior margin of the corpus cavernosum, extending distally about $2\frac{1}{2}$ cm., thence curving upward and across the dorsum and downward upon the other side to join a corresponding horizontal incision upon the opposite side. This dorsal flap is to be made so that the transverse incision across the dorsum is well back of the neoplasm through healthy tissue. The inferior flap is made by a transverse incision across the lower surface of the organ at a point $\frac{1}{2}$ cm. distal to the beginning of the longitudinal incisions on each lateral aspect. Now dissect the corpus spongiosum from the inferior surface of the fibrous sheath of the cavernous bodies and divide the corpora cavernosa at right angles to the long axis of the organ at the base of the dorsal flap. Remove the sound from the urethra, dissect the urethra free for $\frac{1}{2}$ cm. distal to the base of the inferior flap and divide it transversely at this point, completing the amputation. Catch and ligate the dorsal arteries, the vein and the artery of each corpus cavernosum. Remove the tourniquet. Pass 2 or 3 transverse stitches of catgut across the extremities of the corpora cavernosa through their sheaths and septum and tie.

Draw the dorsal flap down over the stump, button-hole it for the exit of the urethra, which is slit at 1 or 2 points and sutured by interrupted stitches of silk to the margin of the button-hole. Adapt the edges of the dorsal to those of the inferior flap with interrupted stitches of silk. Pass a catheter to the bladder. Apply a close-fitting dressing and fix a catheter to this to retain it in place.

Results.—Amputation with excision of lymph nodes in groins: 38 per cent. cured (Barney, 2).

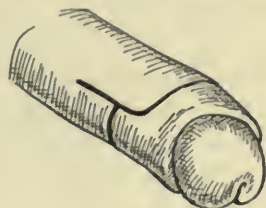


FIG. 12.

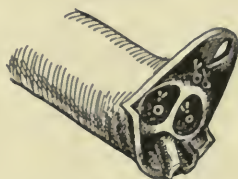


FIG. 13.



FIG. 14.

FIGS. 12-14.—AMPUTATION OF PENIS. Flap operation.

EXTIRPATION OF THE PENIS

Indications.—Malignant neoplastic disease of the penis (as epithelioma, carcinoma, sarcoma) demands extirpation of the penis for the radical removal of all involved tissue. It is comparable with the complete removal of similar neoplasm in the breast. Where the lymph-nodes are involved or from the

character of the disease are likely to contain metastatic extensions, clinically unrecognizable, these should be removed first and en masse with the penis and the serotal tissue about the base of the penis. The removal (emaseculation) or retention of the testes and serotum at the same time is a question which the surgeon and his patient must determine. The removal of the testes, whose vascular and lymphatic systems are entirely separate from that of the penis and serotum, is not necessary for the eradication of disease or neoplasm of the penis and serotum. On the other hand, the value of retention of the testes for their internal secretion is still problematic. Most authorities agree that total emaseculation is the advisable procedure only when very advanced or very malignant disease is present. In view of the comparative slowness of growth, infrequency or tardiness of metastatic deposits and the lesser tendency to cachexia compared with cancer elsewhere, the simpler procedure of amputation with removal of the lymph-nodes in the groins and in Scarpa's triangle is advised in the early stages but this is not an eradication of the disease for the reason that if the glans presents a growth and the inguinal lymph-nodes require removal then the intervening tissue of the stump of the penis through which the lymph vessels course should be viewed as also involved.

Instruments.—The required instruments are:

Scalpel.

Scissors, straight and curved.

Forceps: dissecting (2), toothed (2).

Hemostatic forceps (6-12).

Kocher hemostatic forceps (6).

Sound, 24 French.

Needles.

Needle holder.

Catgut, silk, silkworm-gut.

Method: Dorsal Position.—Make incisions from the spine of the ilium on each side parallel with Poupart's ligament and 2 cm. above it to the median line 2 cm. above the base of the penis. Deepen these to the aponeurosis of the external oblique muscle and dissect out the entire chain of lymph-nodes and vessels en masse with all the subcutaneous tissue overlying them on each side, beginning at the upper outer angle of each incision and working downward and inward so that these 2 masses of tissue are connected only with the subcutaneous tissue of the penis and may be removed with it. Put the patient in the lithotomy position with the thighs widely separated. Now make incisions through the skin and deeper tissues of the serotum down to the tunica vaginalis on each side, starting the incision from the spine of the pubis and extending it downward across the lateral aspect of the serotum to the posterior aspect, where the line of incision turns inward to the median line of the perineum at the perineoserotal junction. Pass a sound through the urethra and hold it in place. From the median line of the perineum dissect this serotal flap up, separating the tissues to either side along the raphe of the

scrotum at the same time, until the corpus spongiosum is exposed. Lifting this median scrotal flap up and retracting the tissues to either side of the median line, dissect the posterior portion of the corpus spongiosum (bulb) free from the fibrous corpora cavernosa back to the anterior layer of the triangular ligament and for a distance of 6 to 8 cm. anterior to the ligament, at which point the corpus spongiosum (and urethra) is divided.

Place an hemostatic forceps upon each side of the free margin of the urethra to control in part the oozing of blood which occurs from the spongy tissue and put the urethra aside until the later stages of the operation. Proceed to the removal of the penis above the base at the symphysis pubis, dissecting all the tissues overlying the symphysis in 1 mass with the masses of lymph-nodes and penis. Divide the suspensory ligament. Catch in hemostatic forceps the dorsal vein and the arteries, divide and ligate them. The crura are now dissected out readily to their bony attachments. Strong clamps (Koehler) should be applied to each crus about 1 cm. from the bony attachment, and several ligatures passed through the substance of the crus between the forceps and the bone and tied to secure all bleeding. Divide each crus near to the clamp, and the penis with the attached tissues is removed. The testes may now be removed by ligating and dividing the easily

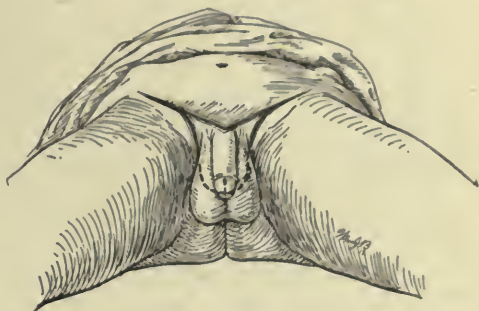


FIG. 15.—INCISIONS FOR EXTIRPATION OF PENIS.

accessible spermatic cords, as in orchidectomy. Now draw the urethra down to the median line of the perineum, slit it for $\frac{1}{2}$ cm. above and below, and suture it to the margin of the skin of the perineum and scrotum with several interrupted catgut or silk sutures. Approximate the skin margins by suture with silk-worm-gut and catgut. Several drains of folded rubber dam or rubber tissue should be placed in the wound to allow the escape of oozing



FIG. 16.—SUTURE LINES AFTER EXTIRPATION OF PENIS. Urethra appears at lowest point in perineum.

blood. These drains may be removed in 24 hours. Dressings are held by a wide T-bandage or double spica and T-binder. The bladder may be drained by a retained catheter through the urethra or the dressing may be applied so that the urethra is easily exposed and regular catheterization may be ordered.

OPERATIONS FOR CONGENITAL DEFECTS OF THE PENIS AND URETHRA

The purpose of operative efforts for the relief of congenital defects of the penis and urethra is to produce a more efficient organ than that with which the individual was endowed by nature and to produce an organ more closely resembling the normal. Balanic or anterior penile hypospadias may be efficient for all physiologic needs and demand no surgical relief. An abnormal appearance may often be corrected by surgery. It is in many cases better to provide a free direct outlet for urine and semen rather than, in case of a minor defect, to produce a traumatic (operative) stricture of any part of the channel. The objects sought and the probable result obtainable through surgical means should be carefully weighed in each case. In most cases of congenital defect of the urethra there are associated defects of the penis, such as curvatures, abnormal bands and contractures, which must be remedied before re-formation of the urethra is undertaken and in many cases the external orifice may be produced by some plastic method at the same time that these corrections of the shaft of the penis are made. Total absence of the urethra, observed in very few cases, is usually associated with other major defects of formation in the urinary organs. Congenital fistulæ or channels parallel with the urethra (double urethra) as well as occlusion of the canal, complete or partial (congenital strictures), and diverticulæ or sacculations are of great rarity and must be dealt with surgically according to the methods employed for similar acquired pathologic formations.

Perineal drainage through a catheter by an external urethrotomy must often be provided, before operation upon the anterior urethra, to avoid soiling the plastic work by urine or subjecting it to strain during the process of healing. Primary union is an essential to complete success. Even the simplest of these procedures may require 2 or more operative steps at intervals of weeks or months.

In infants, as well as in young boys or men, the physiologic changes in size, vascularity and tension to which the penis is subject must be taken into account; for failures in many cases are attributable only to these changes during urination and erection. Infants must be controlled so that handling of the parts, dressings, etc., shall be avoided.

Hypospadias occurs in one of its forms in about 1 in 300 males, the minor grades of balanic and balanopenile hypospadias far outnumbering all others.

Epispadias occurs more rarely still. Baron observed 300 cases of hypospadias to 2 cases of epispadias. (Legueu.)

Epispadias and exstrophy of the bladder are commonly associated and incontinence of urine is usual with penile or complete epispadias, i. e. absence of the anterior portion of the posterior urethra and of the vesical and urethral sphincter muscles. Exstrophy of the bladder has been estimated to occur once

in 50,000 births. Exstrophy of the bladder and epispadias are usually associated with other developmental defects, such as separation of the pubic bones, absence of prostate, fistula of the (patent) urachus, cryptorchism, hernia, etc.

Age suitable for operation, 6 to 10 years.

HYPOSPADIAS

Hypospadias is the defect in which an abnormal opening of the inferior wall of the urethra presents in the glans penis (balanic), on the inferior surface of the shaft (penile), or in the scrotum or perineum. This defect may exist without maldevelopment of the penis, but marked defect of the penis usually is found with the forms of penoscrotal and scrotoperineal hypospadias, in which forms the scrotum may be bifid and other manifestations of errors in development (undescended testis) may coexist. The posterior urethra is normal and the control of urination is maintained. Plastic operations of many varieties have been put forward for the relief of the difficulties which this deformity causes, difficulties in ejecting the urine and difficulties in erection and in the deposit of semen within the vagina. Contractures and curvatures of the penis must first be removed by plastic operations performed and completely healed before the restoration of the urethral tube is attempted.

Method of Duplay.—This method is indicated in suitable cases where the meatus is found just posterior to the glans. The meatus or portion of the canal through the glans penis is formed by denuding 2 planes on each side of and parallel with the urethral sulcus or proposed canal and suturing these 2 denuded areas together by means of silver wire over a catheter. To gain space for this catheter, it may be necessary to make an incision upward into the substance of the glans or 2 oblique lateral slits upward, as in Figures 1 and 2. This new-formed canal is united to the meatus by denuding the margins of each and suturing.

Method of von Hacker.—This method consists in mobilizing the meatus and anterior portion of the urethra, tunneling the glans, and advancing the urethra through this tunnel. Introduce a sound or bougie in the urethra and make an incision about the meatus at a little distance from the margin and down the median line of the inferior surface of the penis over the urethra. Through this incision carefully dissect out the urethra to make it free to such an extent as will allow of its elongation by stretching to the surface of the glans. Now pass a narrow-bladed straight bistoury (on the flat) from the site of the hypospadiac opening beneath the skin and through the spongy tissue of the glans penis, emerging at the site of a normal meatus. Turn the knife over and make this a cruciform tunnel through the glans. Pass forceps from in front through the tunnel, grasping the end of the mobile urethra and draw this through. Suture the margins of the urethral opening to the margins of the new-formed meatus by 4 or more silk sutures and close the

skin wound on the inferior surface of the urethra with silk sutures. A retained catheter is not necessary.

For hypospadias in which the urethral opening is more than 3 cm. from the face of the glans penis other procedures than the above are necessary.

Method of Nove Josserand.—The method of Nove Josserand is divided into 3 stages.

STAGE 1.—Make a perineal urethrotomy, suturing the membranous urethral margins to the skin. Carry out the necessary plastic operations upon the penis to remove contractures, incurvation and adhesions in the skin, subcutaneous tissue or sheath of the corpora cavernosa. Division of the spongiosum is

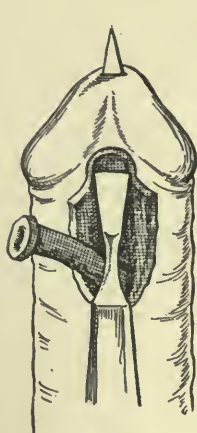


FIG. 17.



FIG. 18.

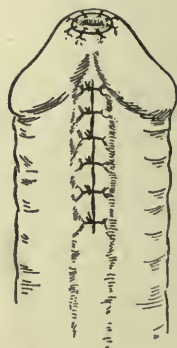


FIG. 19.

FIGS. 17-19.—STEPS IN VON HACKER METHOD FOR HYPOSPADIAS.

sometimes necessary. With a bougie in the hypospadiac meatus, dissect out the meatus and mobilize the urethra for a distance of 2 or 3 cm. Ligate the urethra with catgut and bury the stump under the spongy and subcutaneous tissue. The penis is then fixed in a dressing against the abdominal wall. Two or 3 months must elapse before proceeding.

STAGE 2.—A small trocar and cannula, with the penis held straight, are made to enter the tissues behind at the urethrostomy and directed forward in the axis of the penis between the inferior surface of the sheath of the corpora cavernosa and the skin of the ventral surface of the penis. Then burrow through the tissues in the course of the urethra, emerging upon the glans in the situation of the normal meatus. The trocar is removed from the cannula, which is left in place. A graft of hairless skin, size 4 cm. by 1 cm., is cut from the internal surface of the arm or the external surface of the thigh of suitable shape to be wound in spiral form about a catheter of the proper diameter to pass through the cannula. The cutaneous surface of the graft is applied to the catheter, with its raw surface outside. The edges of the spiral turns are held together by fine catgut stitches and the extremities of the graft are ligated about the catheter with catgut. The graft must be long

enough to extend beyond the new-formed meatus in front and beyond the urethrostomy wound behind. The catheter covered by graft is passed through the cannula and the cannula withdrawn. The ligatures about the extremities of the graft and catheter should extend very little beyond the new-formed tunnel at the meatus and urethrostomy.

No catheter is placed through the urethrostomy into the bladder for continuous drainage. The catheter bearing the graft is removed on the eighth

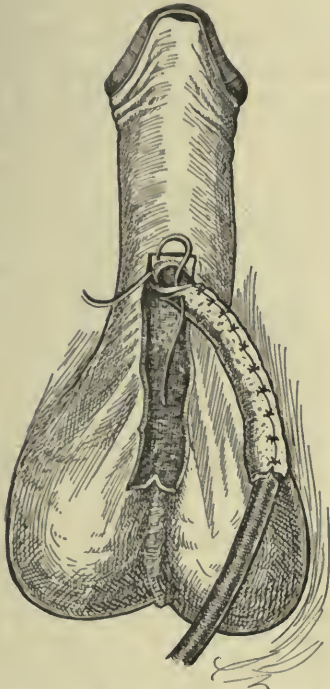


FIG. 20.—ROCHET OPERATION FOR HYOSPADIAS.

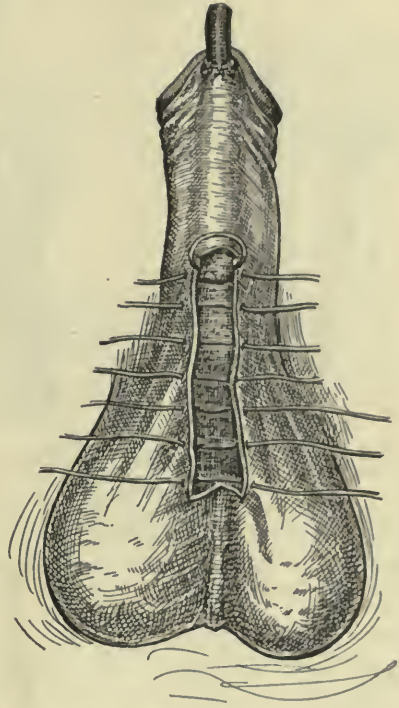


FIG. 21.—ROCHET OPERATION FOR HYOSPADIAS.

day. This canal contracts somewhat. After 3 or 4 weeks sounds of small size are gently passed and at the end of about 10 months an internal urethrotomy may be done. Gradually urine will find its way through the new canal.

STAGE 3.—Closure of the perineal fistula is only undertaken after the new canal is well formed, without fistulæ, etc.

Method of Rochet.—A graft is made from the anterior surface of the scrotum whose base is just posterior to the hypospadiac meatus. This is sutured over a catheter to form a new canal of skin and this new-formed tube is passed through a tunnel formed by means of bistoury or trocar and cannula between the skin of the ventral surface of the penis and the sheath of the corpora cavernosa, as in the Nove Jossierand operation. This graft is less fragile and better nourished than that of the Nove Jossierand method, but carries hair

follicles within the urethral canal, which almost invariably give rise to troublesome irritation, infection, deposits of urinary salts, etc.

The methods of Landerer, of Duplay, and many others may serve in certain cases, but the results of the Nove Jossere procedure have been favorable.

Method of Beck.—A small perineal urethrotomy should be made and a catheter inserted for bladder drainage during the formation of the urethra.

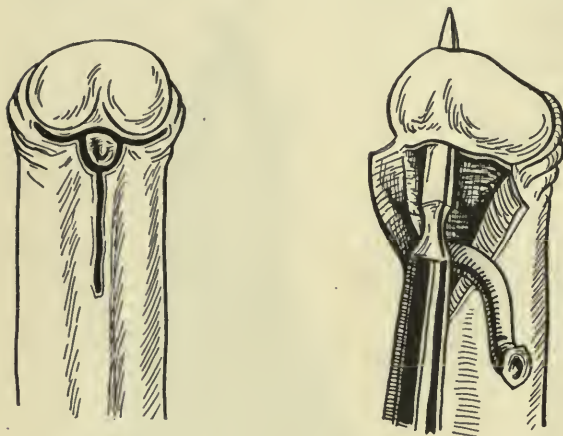


FIG. 22.—BECK'S OPERATION FOR HYPOSPADIAS.

Make an incision to each side of and parallel with the urethral depression or gutter in the skin of the penis, from the face of the glans in front to the hypospadiac opening behind, and connect their anterior and posterior extremities by transverse incisions, thus forming a flap whose sides are dissected free so as to be folded over and sutured together in the median line over a bougie or sound, to form a tube whose inner surface is epidermis. With the

posterior extremity of this denuded area upon the ventral surface of the penis as its base, a flap is cut from the anterior face of the scrotum, corresponding in size and shape to the area on the penis, and this scrotal flap is dissected entirely free except at its base. This is swung about so that its raw surface covers the denuded area of the penis and the newly formed urethral canal, and is maintained here by suturing the lateral margins and by suturing the anterior extremity to the edge of the glans and urethral meatus. The scrotal wound is sutured.

(I prefer the operation of Beck to others.—EDITOR.)

EPISPADIAS

Epispadias, the deformity characterized by the abnormal opening of the urethra upon the dorsal surface of the penis, is very rare except as a part of the greater deformity in which the anterior wall of the bladder, the sphincters of the bladder and urethra and the symphysis pubis are all lacking, so that as a functioning organ of the urinary or genital systems little can be gained by plastic operations except in rare and favorable instances.

The operative treatment of epispadias in these cases is of minor importance, over which the formation of a reservoir for the urine takes precedence.

Operation upon the usually short, deformed penis presenting epispadias

should not be undertaken without previous diversion of the urine so that it may not soil the operative field. For this purpose a perineal urethrostomy is necessary. The straightening of the penis must also be done before proceeding to the repair of the epispadias. The formation of the perineal drainage of the bladder and the improvement of the form of the penis may be undertaken at an operation which precedes the formation of the new urethra by as long a time as is needed for complete healing of these wounds.

The second stage of the operation, consisting in the formation of an urethral canal, may be performed by any of the following methods.

Cantwell's Method.—Cantwell's operation (11) should be placed first as the best for anatomical restoration of the urethra to its normal position.

After providing perineal drainage of the bladder by external urethrotomy, dissect out the mucous membrane of the urethral furrow from the extremity of the glans to

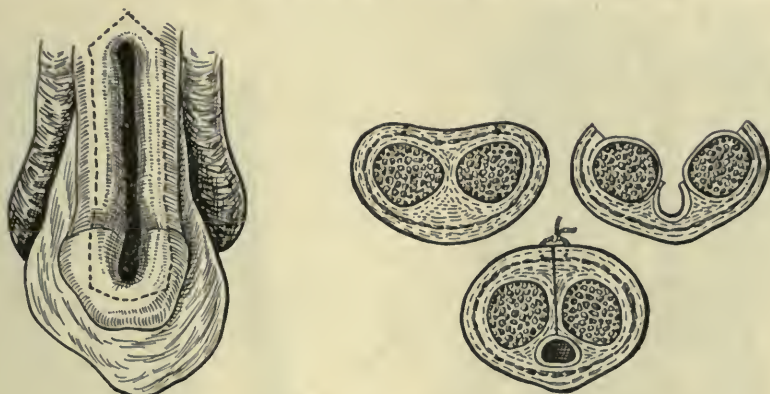


FIG. 23.—SHOWING STEPS OF CANTWELL'S OPERATION FOR EPISPADIAS.

the symphysis by longitudinal incisions along the mucocutaneous junction on each side of the groove connected over the glans and about the opening into the bladder, raising with the mucosa all tissue down to the corpora cavernosa, including, if possible, part of the fibrous sheath without cutting through the sheath at any point. Separate the urethra from its bed throughout. Split the septum between the 2 corpora cavernosa to the skin of the ventral surface of the penis and place the urethra in its normal position, just above the skin of the lower surface below and between the 2 corpora cavernosa, and maintain it here by a few stitches of catgut. With a bougie or rod along the urethral groove, suture its lateral margins over it to form a tube which is passed through a perforation or tunnel through the glans and sutured at its margins. Approximate the corpora cavernosa again and close the skin of the dorsal surface. Cantwell found the corpora cavernosa separable easily by blunt dissection in 2 cases of epispadias.

Method of Duplay.—This procedure is applicable when the urethral sulcus is deep enough to give a canal of proper caliber. Two parallel areas are denuded upon each side of the urethral sulcus from the face of the glans penis to the margin of the epispadiac opening and these 2 areas are sutured together with silver wire over a catheter placed in the sulcus. After healing of this

simple urethrorrhaphy, the posterior extremity of the new canal so formed is united by suture to the margins of the epispadiac opening. The prepuce may be utilized to complete the meatus.

Method of Thiersch.—Two rectangular flaps are made on each side of the urethral gutter. Make one flap by a longitudinal incision upon the summit of one margin of the urethral furrow, running parallel with the furrow for its

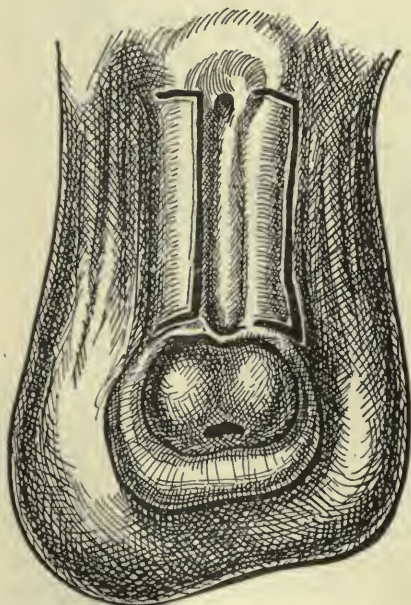


FIG. 24.—EPISPADIAS. THIERSCH OPERATION.

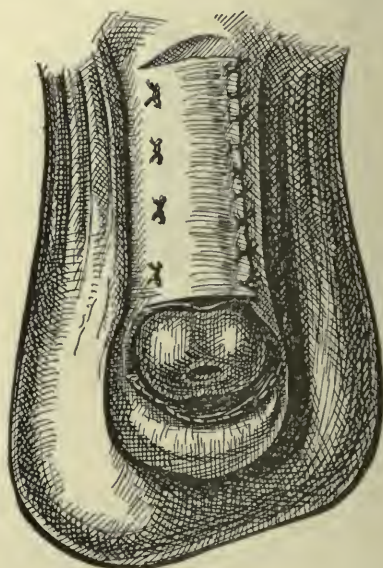


FIG. 25.—EPISPADIAS. THIERSCH OPERATION.

entire extent, and from each extremity of this incision carry a cut at right angles out over the side of the penis. Dissect up this flap which is to become the external covering of the canal formed by the next flap. Its base lies along the outer aspect of the penis.

The other flap is made by carrying 2 transverse incisions from the anterior and posterior extremities of the other side of the urethral furrow outward over this side of the penis for a distance of 1 cm. or more, and the extremities of these transverse incisions are connected by an incision which lies upon the outer side of the penis running parallel with its axis. This flap is dissected up so that its base runs along the margin of the urethral furrow and it is turned over the furrow so that its skin surface forms the roof of the new

urethra and its raw surface is exposed over the new channel. Its longitudinal margin is sutured along the line of the base of the first flap by sutures passed through the first flap along its base line. The flap first made is then drawn over the new-formed urethra and its longitudinal margin sutured to the corresponding margin upon the outer limit of the denuded area on the opposite side of the organ. After complete healing of the parts in this operation, there remain the 2 orifices at the anterior (meatus) and posterior (epispadias) extremities of the new canal to be closed. The anterior is closed by a small plastic operation in which the prepuce or redundant skin near the corona is utilized as a flap and sutured to the freshened margin of the urethral orifice. The posterior is closed by flaps taken from in front of the pubis, one turned down to be sutured to the margin of the posterior end of the canal and a second swung down to cover the raw surface of the first.

Beck's Operation.—Beck's operation for epispadias consists in an incision about all the mucous membrane of the epispadiac orifice and furrow and the dissection of this membrane free with the mobilization of as much of the urethra as possible toward the bladder. It is important that sufficient tissue (mucous membrane and skin) extending upward upon the symphysis, if necessary, be taken to form the superior wall of the urethra as far as the face of the glans penis without undue traction. The glans penis is now perforated by bistoury or trocar and cannula to form a channel whose anterior extremity shall lie in the position of the normal meatus. The mucous membrane mobilized above is now drawn down through the channel in the glans and its margins are sutured to the margins of the new-formed meatus on the face of the glans.

OPERATIONS FOR CONGENITAL DEFECTS OF THE TESTIS

UNDESCENDED TESTIS

(Cryptorchism, Ectopic or Retained Testis)

The chief congenital defect of the testis requiring surgical treatment is that by which it may be arrested in any part of its course of descent from below the kidney and behind the peritoneum to the lower part of the scrotum. The testis so retained is usually small and more or less atrophic but may possess spermatogenetic function. The testis may be found within the internal ring, in the inguinal canal in front of the pubis, or (ectopic) beneath the skin of the abdomen in the angle between scrotum and thigh or in the perineum. The vas deferens is usually of adequate length, but the spermatic vessels are the chief factors in the deficient length of the cord. These are the vessels commonly ligated and resected in the operations for varicocele, so that ample evidence demonstrates that they are not essential for the nourishment of the testis. If, however, they are divided the viability of the testis

is dependent upon the artery of the vas deferens. The scrotum, though small, if not occupied by the testis, is readily distensible and will accommodate itself to any size, as is observed in cases of undescended testis with a large hernia occupying the scrotum.

Indications.—Operations should not be undertaken until after the second year (3 years of age) unless accident or strangulation of hernia compels operation earlier, according to Mosehcowitz (30). Hernia, partial or complete, due to an abnormal persistence of the peritoneal pouch which precedes the descending testis during development, is almost always associated with undescended testis. Because of the presence of the testis in the inguinal canal with this hernia, a truss cannot be worn, so that operation is necessary for this condition as well. The testis is subject to injury, often to repeated injury. Neoplasm is prone to develop in these defective testes. Torsion of, or injury to its blood-supply may take place.

Inflammation in the undescended testicle, such as may arise with mumps or gonorrheal infection, presents serious aspects by reason of great swelling within the confinement of the aponeurotic coverings and may threaten life by infection of the peritoneum. The functional capacity of the organ may be improved by placing it under normal conditions. The normal appearance of the external genitals is restored by successful operation.

Anesthesia.—General.

Instruments.—The following instruments are required:

Scalpel.

Scissors.

Forceps, dissecting and toothed.

Grooved director.

Hemostatic forceps.

Full-curved needles.

Catgut for ligatures and sutures.

Kangaroo tendon for sutures.

Silkworm-gut or silk.

Bevan's Method (4, 5).—Incise as for radical inguinal hernia operation from the external inguinal ring upward and outward 6 to 8 cm., down to and exposing the aponeurosis of the external oblique and slit this aponeurosis, dissecting free its upper and lower flap, exposing the inguinal canal and spermatic cord and Poupart's ligament. Isolate the hernial sac, beginning at the internal ring, by carefully cutting through the cremasteric muscle and fascia and the transversalis fascia. Open the sac. When the testis is intra-abdominal, it should be sought for within the internal ring and brought out into the wound. The sac may be very thin, "like tissue-paper," and must be liberated with great care, especially from the vas deferens. The artery of the vas will be essential for the viability of the testis if the spermatic vessels are to be divided later on, so that the vas and its adjacent vessels must not be grasped by forceps or injured in any way.

The peritoneal sac is transfixed and ligated or closed by a purse-string suture at its neck at the internal ring and transversely divided external to the ligature. The lower end of this sac containing the testis is cut across above the testis and sutured over the testis to form a tunica vaginalis (Mosechowitz does not suture the sac over the testis), and the intermediate portion of the sac is thus removed. Tense fascial bands are found extending from the cord to surrounding tissues, which must be cut to free the cord. It will now be

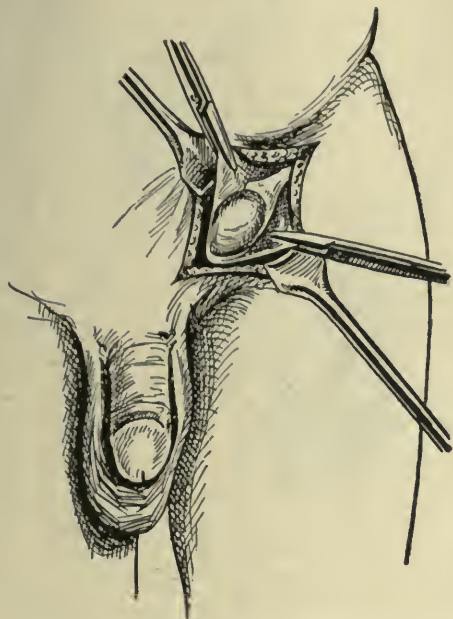


FIG. 26.—BEVAN'S OPERATION.

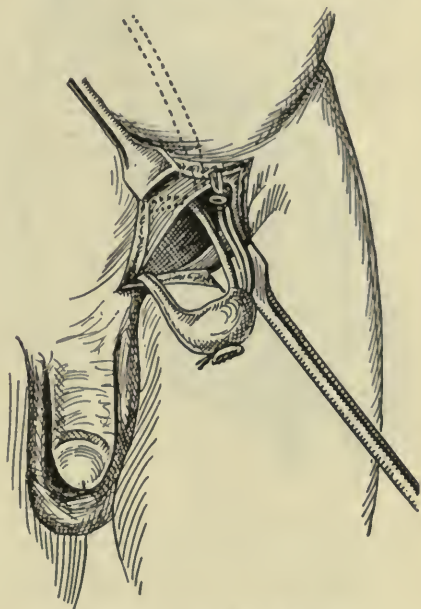


FIG. 27.—BEVAN'S OPERATION.

found in some cases that the cord has been sufficiently lengthened to reach the lower limit of the scrotum, but if this is not the case, traction on the cord will demonstrate that the spermatic vessels are restricting it. By dissection of the fine intervaseular fascial bands, the cord may sometimes be given increased length but usually the spermatic vessels (carefully separated from the vas and its vessels) must be divided between 2 ligatures. The corresponding serotal sac is now entered from the lower angle of the incision with 1 or 2 fingers or forceps, and a cavity within it is stretched to receive the testis covered by its tunica vaginalis. The testis is maintained within the scrotum by a stitch or 2, or a purse-string suture, just below the external inguinal ring, about the neck of the scrotum, seeing to it that the vas or cord is not compressed. The wound is then sutured in layers as in the radical operation for hernia without transplanting the cord.

Mosechowitz notes frequent swelling about the testis on the second or third day after operation, which disappears after applying a hot water bag. He regards the condition as cured only when the testis remains in the lowermost part of the scrotum. Suture of the testis to the scrotum and traction on

the cord by variously devised sutures are entirely unnecessary. (See also Hernia.)

Dangers and Difficulties.—This operation entails the following dangers and difficulties:

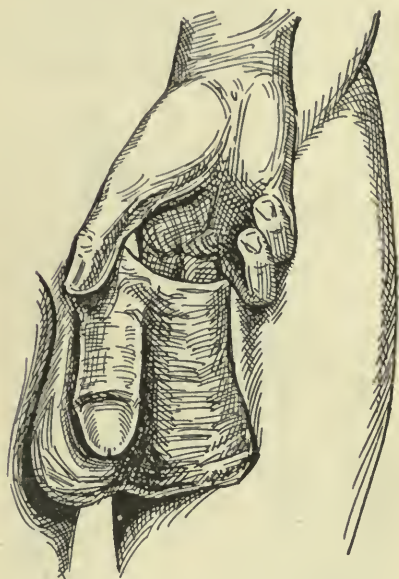


FIG. 28.—BEVAN'S OPERATION.¹

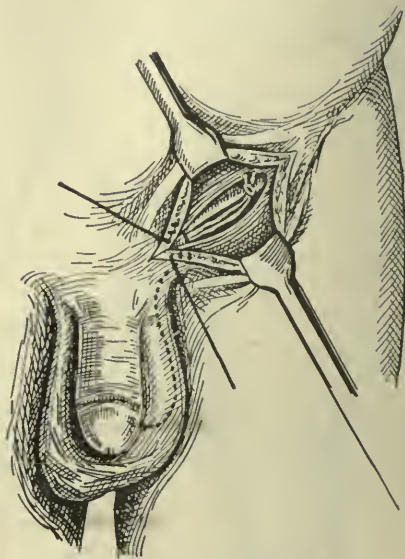


FIG. 29.—BEVAN'S OPERATION.

Injury to the vas or the artery of the vas in manipulations.

Torsion of the vas.

Sac torn and "shredded out."

OPERATIONS FOR CONGENITAL DEFECTS OF THE BLADDER

The congenital abnormalities of the bladder demanding surgical relief are exstrophy, diverticulum, and patency or cyst of the urachus.

EXSTROPHY

It has been estimated that more than half of the subjects of this defect who do not receive surgical relief die before the tenth year of life (29, 32). This deformity is always associated with epispadias. No palliative measures for the collection of the urine have been found adequate. Relief is to be obtained only through operations which will (1) restore a closed reservoir by plastic operation or (2) exclude the bladder and divert the urine. Plastic operations which successfully restore the anterior bladder wall afford simply a means for better control of the incontinence of urine. The formation of a

vesical sphincter to overcome the chief distress of these sufferers, incontinence of urine, has not been assured by any of the procedures presented. Many ingenious methods have been employed in discarding the bladder and resorting to the intestine, rectum, sigmoid, cecum, and small intestine as the reservoir, utilizing the anal sphincter for control in different ways.

Various degrees of abnormality of this type have been noted, from the association of an abnormal thinness and cicatricial appearance of the anterior abdominal wall, with intact but thin bladder wall and without separation of the symphysis, to a fissure of lesser or greater extent of the abdominal, pelvic, and vesical walls. Complete exstrophy is most common, and its treatment is here considered.

Anatomic Features.—The following anatomic features are to be noted: The penis is short, flattened, and epispadiac; the scrotum is diminutive, often empty by reason of associated ectopic testes; the prostate may be absent or rudimentary; the seminal vesicles, poorly developed; the anterior abdominal wall is lacking in the median line and weak recti abdominales muscles are inserted into the separated and stunted pubic bones on each side; the vesical sphincter is always lacking; an acute inflammation of the vesical mucosa is usually present, and infection often involves the ureters and renal pelves, so that pyelonephritis exists; the perineal muscles may be deficient (rectal incontinence); a cloacal opening between the ileum or cecum and the bladder floor may be found with atresia of the anus.

A few only of the many diversified surgical procedures for the restoration of the bladder's function are here described; others must be sought in the voluminous literature.

The plastic procedures to form an anterior wall for the bladder, and the closure of the cleft of the abdominal wall over this, demand patience and ingenuity in the tedious, often repeated attempts to obtain union of sutured surfaces because of infection, failure to hold and fistula-formation. The lack of a sphincter after the healing of the plastic work leaves the unfortunate sufferer with simply a narrower and, therefore, better controlled outlet for the constantly escaping urine, so that a urinal is more effectively adjusted but these artificially closed urinary reservoirs tend to the formation of calculus or to the deposit of salts upon the new-formed wall, especially when the skin utilized in flaps carries hair or hair follicles, giving as great distress as the exposed, sensitive vesical mucosa of the original defect and leading readily to ascending ureteral and renal infection (pyelonephritis) which is also the *bête noire* of transplantation of the ureters, nephrostomy, etc.

The plastic operations for the restoration of the bladder are not advocated by most authorities to-day. One of the various methods of bladder exclusion, with the diversion of the course of the urine, is generally adopted with subsequent closure of the abdominal wall by plastic means (1, 24).

The most favorable time for operation is after the fifth year.

METHODS OF PLASTIC CLOSURE OF THE BLADDER

Method of Wood (44).—The hair is first removed, by destruction of follicles, from the flap to be used for the anterior bladder wall. Under general anesthesia, cut a flap which is larger than the space to be covered from the skin of the abdomen above the bladder. The base of this flap lies above the upper margin of the mucous surface of the bladder, and it should possess skin at least $\frac{1}{2}$ cm. in width above the bladder as a hinge. This is turned down and sutured to the freshened margins of the bladder all about, except over the urethral furrow, which must be left open for free escape of urine. Thus the

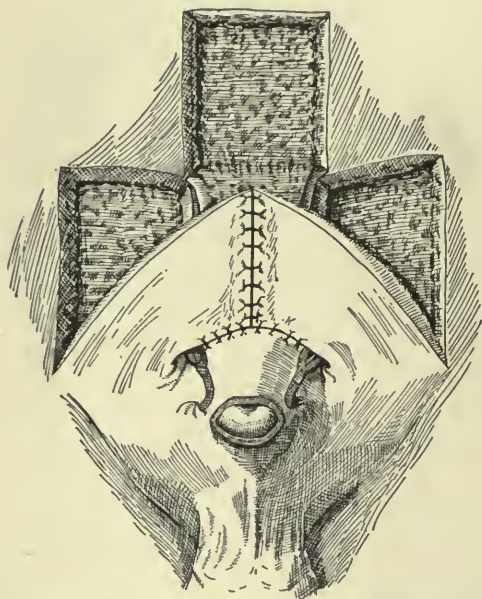


FIG. 30.—WOOD-LE FORT OPERATION. Exstrophy of bladder.

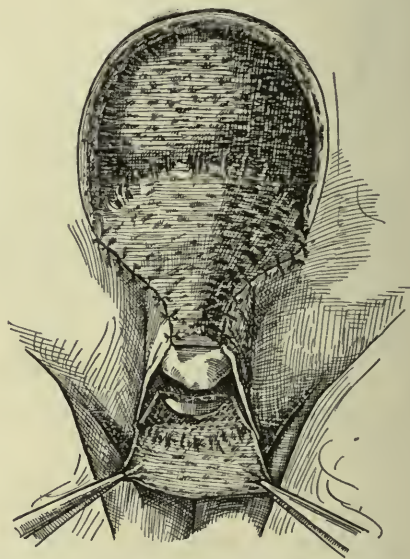


FIG. 31.—SECOND OPERATION FOR EXSTROPHY.

skin surface of the flap becomes the anterior surface of the bladder cavity and its raw surface is external on the level of the skin of the abdomen. Two lateral flaps are cut from the skin, external to the bladder and the first flap, on each side, whose bases lie in the inguinal regions. Each of these is swung over the raw surface of the bladder region and they are sutured together. The bared areas of the abdominal wall are closed as far as possible by sliding the skin over them from all sides, and the remainder uncovered is closed by Thiersch or other grafts.

Le Fort (22, 23) followed Wood's method and added to it the closure of the epispadias by utilizing the prepuce. He proceeded by steps in the operation at intervals of months, obtaining successful closure of the defect in 9 out of 10 cases operated upon. None of these cases was relieved of urinary incontinence, but a urinal was easily adjustable.

Thiersch (40) used lateral abdominal skin flaps.

Lorthior (26) used the distensible skin of the scrotum, after total emasculation, to form the anterior bladder wall.

Method of Segond.—This method consists in using the upper portion of the ectopic bladder to close in the lower portion, by suturing its margins together and along the sides of the epispadiac groove, with the redundant prepuce brought up from below, button-holed transversely to allow the glans to pass through it, and then sutured over the anterior portion of the bladder flap for a skin covering as far as it will extend. This produces a very small pouch but, when successful, facilitates the wearing of the urinal. The exposed surface above the bladder is closed by plastic methods.

Other plastic operations for providing a mucous anterior surface of the bladder have been those of Rutkowski and of Mikulicz, using a segregated loop of small intestine.

Trendelenburg's Operation (41, 42).—By an incision about 8 cm. long over each sacroiliac synchondrosis, open these joints by dividing their ligaments and interarticular cartilages. Now pressure upon the crests of the ilia will approximate the pubic bones. Suture the skin incisions made and apply dressings. By means of a special sling about the pelvis, with crossed traction, the patient is kept in a position favorable for the approximation of the pubic bones for several months until firm union of the synchondroses in their separated positions has taken place. Then the freshened margins of the bladder opening are accurately apposed by suture, leaving a space for drainage. A plastic operation for closure of the vesical outlet (posterior urethra) and formation of a sphincter is carried out.

Trendelenburg has thus produced some results with dilatable, continent bladder and voluntary urination. (Three cases out of 23 so treated—Katz.)

Other methods for restoring the symphysis and so approximating the vesical walls for closure have been devised by Koenig, Berg, Schlange (35), and others.

EXCLUSION OF THE BLADDER AND DIVERSION OF THE URINE

These methods may be divided for consideration into (1) those which result necessarily in incontinence and (2) those which aim to produce retention of urine.

1. Methods Resulting in Incontinence.—Sonnenberg dissected out the ureter openings and transplanted them into the upper end of the urethral furrow and removed the bladder mucosa. The defect in the wall was closed by flaps. Harrison, Rovsing, and others have transplanted the ureters to the skin. Chavasse and Pawlik transplanted the ureters into the vagina. Watson proposes bilateral nephrostomy as for malignant vesical neoplasm.

All of the above methods are palliative and subject to all the difficulties and dangers of the uretero-intestinal transplantation without the advantages gained by relief from incontinence of urine.

2. Methods Aiming to Produce Retention.—The methods resulting or which aim to result in continence of urine are chiefly those which utilize the normal bowel as a reservoir and depend upon the sphincter of the anus for control. The best of these methods would seem to be those of Maydl and Peters.

The method of Maydl has had many champions. It is simple of execution, and its results have been excellent. It presents the disadvantages, however, of exposure of the peritoneal cavity, of malposition or twisting of the ureters into an unnatural course and may readily lead to obstruction or interference with the urinary stream, giving rise thereby to infection of the renal pelvis and kidney.

OPERATION OF MAYDL (28).—Have the sphincter ani thoroughly stretched and wash out the lower colon. Cleanse the ectopic bladder cavity as thoroughly as possible, avoiding all traumatism to the trigonal region, pass catheters well up into the ureters and cover the bladder surface with a pad of moist gauze.

With the patient in the Trendelenburg position make an incision about the periphery of the bladder-cavity a little outside of the mucocutaneous margin, carefully deepen this to expose the muscular wall without opening the peritoneal cavity, and proceed as in extraperitoneal extirpation of the bladder. It is highly important that the ureters be not completely denuded for their vascular and nerve supply should be preserved if possible. Injury to their walls must be avoided, especially when dissecting the trigone free from the urethra. Cut an elliptical or lozenge-shaped flap of the trigone and bladder base including the 2 ureter mouths and passing 1 cm. outside of them, keeping in mind their intramural course and conserving this. Free the ureters for a short distance upward, using care to preserve the vessels about them. Remove the rest of the bladder and cleanse the extraperitoneal wound by irrigation with an abundance of salt solution. Now open the peritoneal cavity by a median incision through the vesical peritoneum, or higher if necessary, and select a loop of the sigmoid, bring it out of the wound, free it of contents and apply rubber covered intestinal clamps, protecting the peritoneum and field of operation with pads. Incise the gut longitudinally on the surface opposite the mesentery to an extent equal to the vesical flap, and after removing the ureter catheters, suture the edges of this flap to those of the incision in the gut all about and cover this line of suture by a layer of Lembert sutures.

Close the peritoneum about the ureters as low in the pelvis as possible. Close the abdominal wound by layer suture, so far as possible, and pack the cavity of the exstrophy below. Apply dressing. Insert a large rectal tube.

MOYNIHAN'S OPERATION (31) is an extraperitoneal procedure after the manner of Maydl's, using all or most of the bladder wall for implantation as a flap into an opening in the anterior wall of the rectum.

GERSONY'S METHOD.—Gersony (17) separated the sigmoid from the rectum, implanted the ureters (Maydl) in the rectum, which became the urinary viscus, and brought the extremity of the sigmoid down through a dissected tunnel to the anal margin outside the mucous membrane of the rectum. The anus thus controlled both the urinary secretion and the intestinal contents. The ureter mouths were eliminated from contact with feces and the rectum served as a reservoir.

A similar condition is produced by the Cuneo (16) (with small intestine) and Heitz-Boyer and Hovelaeque (19) (with sigmoid) operations.

For Nephrostomy see Operations upon the Kidney (Vol. IV, Chap. XII).

PETERS' OPERATION (34).—General anesthesia is employed. Stretch the sphincter ani and wash the bowel out thoroughly. Catheterize the ureters. Dissect out a part of the bladder floor and trigone containing the ureter orifices by beginning at the vesico-urethral margin and removing all mucous membrane and underlying muscle,



FIG. 33.—PETERS' OPERATION. Showing portion of bladder floor to be excised with ureter mouths.

exercising care, as in the Maydl operation, to protect the ureters and their vessels from injury by instruments or fingers. This vesical flap is divided in the median line so that each half contains a ureter mouth. The ureters may be dissected out separately "with a goodly rosette of bladder muscle and mucous membrane" (Peters). In doing this the course of the ureter obliquely through the bladder muscle must be observed, and the incision

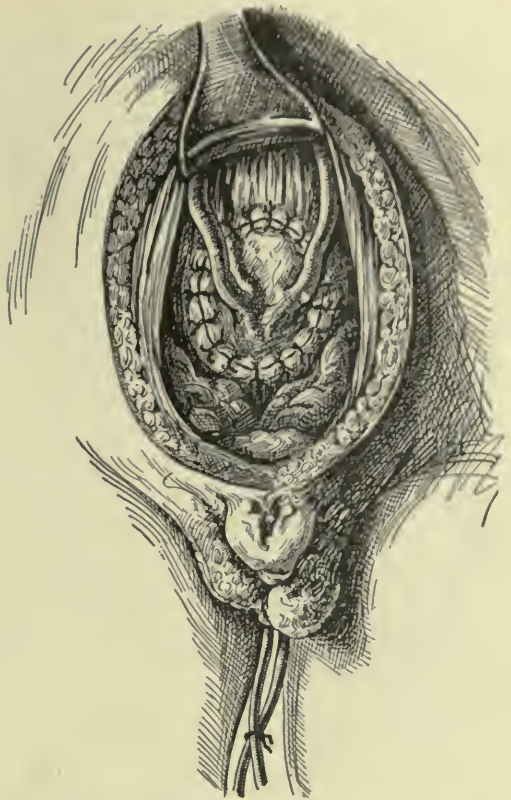


FIG. 32.—MOYNIHAN'S OPERATION. Bladder base with ureters implanted in rectal wall.

made to include all of this part with great care. Mobilize the ureters by guarded blunt dissection for a short distance. Remove all of the remaining bladder wall without opening the peritoneum. Bluntly push the peritoneum

up from the anterior surface of the rectum so as to expose an area high enough to permit the ureter to be implanted and project $\frac{1}{4}$ to $\frac{1}{2}$ in. into the lumen of the bowel without stretching. Now make a puncture wound upon a clamp or forceps inserted through the anus in the lateral (not anterior) wall and draw the folded ureteral orifice through. Stitch the rectum about the ureter. This procedure is repeated with the ureter of the other side. (See method of implantation under Transplantation of Ureters.) Pack the abdominal wound, which may be closed later by a plastic operation.

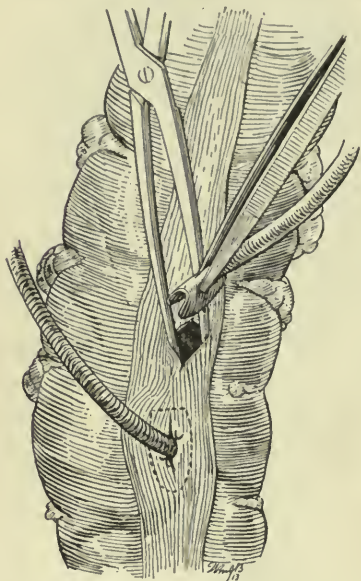


FIG. 34.—PETERS' OPERATION. Ureters implanted in rectum.

NOTE.—It is doubtless preferable to leave the removal of the bladder wall for a later operation after transplanting the ureters. One ureter at a time may be implanted with an interval of 2 to 4 weeks between. In the suture of the rectal wall about the ureter, the Stiles (intraperitoneal) plan should be followed in this extraperitoneal procedure to obtain an oblique course for the ureter and to secure it in place, for a number of the cases of Peters' operation have failed through separation of the ureter from the rectum.

This operation is commonly known under Peters' (Toronto) name in English-speaking countries, although, as Buchanan states, it was carried out (doubtless unknown to Peters) by others before him; by Bergenhem (Sweden) in 1894, Pozza (Italy), F. H. Martin (Chicago) in 1898, and Lendon (Australia) in 1899, according to Buchanan.

RESULTS.—Zesas (39) (1909) reported 71 good results of the Maydl operation in 97 operations and 26 deaths. Buchanan (1909) reported 66 cases of Maydl type operation with 23 deaths, 35 (circ.) per cent. mortality. Buchanan (1909) reported 34 cases of Peters' type operation with 11.5 per cent. mortality (10). Death has been due to pyelonephritis in about 50 per cent. of cases that have died, to peritonitis in about 20 per cent., and to urinary infiltration in about 12 per cent.

OTHER CONGENITAL DEFECTS OF THE BLADDER

Congenital septa, folds or valves producing the rare conditions called bilocular, triple bladder or multiple bladder demand no surgical treatment unless they are obstructive and bring about retention and decomposition of urine, producing intractable cystitis or calculous formation, when division, resection, or excision may be indicated.

Diverticulum of the bladder may be congenital and its treatment is that of the acquired form. Simple exclusion by vivifying and suturing the orifice is not to be commended. Enlargement of the orifice by operative means to

give the diverticulum free communication with the general bladder cavity is in suitable cases an adequate measure. The radical surgical treatment consists in either extra- or intraperitoneal exposure; liberation of the diverticulum from its bed in the pelvis and from adhesions to neighboring structures, with resection at its neck from without or invagination and resection from within the bladder; closure of the wall in layers; and drainage of its site if contamination has occurred.

Packing the diverticulum with strips of gauze, as suggested by Lower (27), will facilitate its removal. The prevesical space should be drained after suture of the anterior bladder wall. If the ureter mouth enters the wall of the diverticulum, it must be transplanted to another part of the bladder wall. Neoplasm in a congenital diverticulum has been observed. This demands wide resection.

Cyst of the Urachus; Patent Urachus.—These rare congenital anomalies are best treated by exposure through the abdominal wall and complete excision without opening the peritoneum, removing the entire cyst or tract and closing by suture of fistulous connection with the bladder. The umbilicus must be removed when in communication with the cyst or urachus, so that repair of the defect, as in umbilical hernia, becomes necessary. Infection of such a cyst or patulous urachus may require incision and drainage for a time until radical removal with closure of the abdominal wall may be wisely undertaken. Tuberculous disease of patent urachus has been observed in conjunction with tuberculosis of the urinary tract.

TRANSPLANTATION OF THE URETERS

The purpose of this operation is to divert the channel, for the kidney's secretion from its normal site of entrance into the bladder to some other part of the bladder, to the other ureter, to the intestine, vagina, or surface of the skin.

Indications.—Indications for transplantation of the ureters are:

1. Those conditions demanding removal or exclusion of the bladder, such as exstrophy; complete epispadias; advanced malignant neoplasm in the bladder, prostate or adjacent organs; tuberculosis of the prostate or bladder without renal involvement; severely painful disease or neurosis of the bladder, prostate, urethra, etc., resection of part of the bladder, including one ureteral orifice.

2. Injury or disease of the ureter, including operative division of the ureter by accident or from necessity; traumatic division of the ureter by gunshot or incised wound; rupture of the ureter; persistent ureteral fistula; aberrant ureter, opening upon the skin, into the urethra, vagina, vulva (incontinence); disease or neoplasm involving the ureter.

Anatomic Points.—The continuity of the ureter should always be restored

by one of the methods of suture when this is possible. The severed ureter should be implanted into the bladder when suture for restoration of its continuity cannot be accomplished. Only when both the distal extremity of the ureter and the bladder are not available for anastomosis should other implantation be considered. The transplantation of the ureter to the intestine is a proceeding of great hazard under the best of conditions and is to be resorted to only when other means fail. Nephrostomy (42) presents less dangers to the life of the individual than does any form of ureterotresis with the divided ureter except ureterovesical anastomosis. The severed ureter brought to the skin of the loin or abdomen is usually subject to obstructive angulation or stenosis in cicatricial tissue with renal infection as the sequel.

Nephrostomy and ureterostomy, which produce the great discomfort and inconvenience of continuous urinary flow to the skin surface, demand the wearing of specially devised apparatus or of accurately adjusted tubes connecting with a urinal attached to the body during the day and arranged to lead to receptacles by the bed at night—always a deplorable condition.

The great value of the preservation of the intramural portion of the ureter with its vesical orifice has been proven by the successful results of the Maydl and Peters methods as compared with all other forms of implantation into the intestine. The severed ureter implanted in the intestine except, possibly, by the Coffey (15) method of artificial valve formation, will commonly transmit infection to the kidney (pyelonephritis).

Two factors of prime importance in the anastomosis of the ureter with another organ are that (1) stenosis of the ureter shall be prevented, so that no partial obstruction to the urinary stream shall be caused which will lead to distention of the ureter and pelvis and result in pyelitis and pyelonephritis; (2) the ureter shall be maintained in its new position without traction. It might be added (as a theoretic ideal) that the ureter should be transplanted into such an organ or in such a manner that infectious material will not be brought into contact with its outlet. This object has been sought in those procedures noted under exstrophy of the bladder which have aimed to form a urinary reservoir from a segregated portion of the intestine and to render this segregated portion surgically clean by treatment over a considerable period before transplanting the ureters to it. The same object is sought when the ureter is implanted upon the skin or into the vagina through surgical cleanliness about its orifice. The ureter must be led to the point of anastomosis without angulation, and its orifice at this point must not be placed at a sharp angle to its course but the normal anatomic course into the bladder obliquely through its wall must be simulated in the transplantation. Failure to observe these anatomic and physiologic provisions more readily results in kinking, stenosis, and subsequent renal infection.

Successful animal experiments and the favorable results of such surgeons as Krynski, Martin, Fowler, Coffey, Mirotworzeff, Stiles, Mayo, and many others point forcibly to the great importance of this feature.

The ureter must be securely fixed by interrupted sutures which catch the adventitia of its wall and which bury it after the manner of the Witzel gastrostomy tube within the wall of a viscus (bladder, intestine). This intramural course must be so constructed as not to produce obstruction. The history of these operations conclusively demonstrates that peritonitis is one of the potent causes of high mortality. In view of this fact an extraperitoneal exposure of the ureter and anastomosis should be made when a choice is offered. Intra-peritoneal uretero-intestinal anastomosis demands the observance of all the laws of intraperitoneal and intestinal surgery.

Uretero-intestinal anastomosis, whether extra- or intraperitoneal, comprehends the opening of the infectious intestinal lumen and the suturing of the gut's wall, both of which are important features in view of the possibility of subsequent infection of the area with failure of sutures to hold the ureter and urinary or fecal fistula as results, which have been common in the history of these operations.

Infection of the kidney or sepsis may result from peri-ureteral lymphatic infection as well as through the lumen of the ureter, and in this possibility lies part of the danger of this procedure.

Peritoneum should be made to cover the anastomosis as a protective by Lembert sutures or by a special flap, and drainage should always be provided. The uretero-intestinal anastomosis should be shut off from the peritoneal cavity when feasible, although successful cases have resulted without this precaution.

Methods.—The proximal portion of the divided and ligated ureter is picked up in the wound or is exposed by one of the incisions described under Operations upon the Ureter, preferably by an extraperitoneal course.

TRANSPLANTATION OF THE URETER TO THE SKIN SURFACE: URETEROTOMY (DERMATO-URETEROTRESIS).—The proximal end of the ureter is stripped from beneath the peritoneum and is brought to the skin of the loin (3 cm. above crest of ilium) or inguinal region (3 cm. above the outer part of Poupart's ligament) in such a way that its course will deviate as little as possible from the normal without sharp curving, angulation or kinking and without traction. The muscles of the loin and the overlying skin are opened by a stab wound. The ureter end is grasped in forceps passed from without inward and drawn to the surface somewhat beyond the skin level, affording some redundancy to allow for subsequent retraction. One or 2 sutures join the muscular or subcutaneous tissue to the adventitia of the ureter wall without penetrating its lumen. The extremity of the ureter is split, and its margins, turned back, are sutured to the skin margins of the stab wound.

The anastomosis of the ureter with the vagina is performed through laparotomy exposure of the ureter, or exposure through the vaginal wall, when the ureter has been divided low enough in the pelvis to reach the vaginal wall without undue traction upon it. This is a transplantation preferable to that to the skin surface of the abdominal wall or loin and gives a more direct course for the duct, presenting, however, the disadvantages and dangers of skin implantation. When the ureter is exposed in an abdominal wound, a long clamp or forceps is inserted into the upper part of the lateral fornix of the vagina on the corresponding side, and a small incision is made from the abdominal side upon this clamp or forceps, through which the instrument is passed and the extremity of the ureter, or a suture attached to it, is drawn through the vaginal opening. The ureter is fixed here by sutures passed through the vaginal wall and the outer coats of the ureter. The patient must then be placed in position for vaginal operation. The orifice of the ureter is split and sutured to the mucous membrane of the vaginal opening. The ureter is readily exposed in its lower pelvic portion through an incision in the underlying anterior vaginal wall and has been injured or divided in operations carried out per vaginam. Its severed proximal extremity, when found, is grasped in forceps, drawn through the vaginal wound, and sutured as above noted, or it is brought through a separate button-hole opening made for it and the orifice formed in the same fashion.

The dangers and difficulties of this procedure are angulation, contracture, constriction of the ureter at the point of outlet or in its course, with consequent hydro-ureter and hydronephrosis and renal infection. No sphincter is provided, and all the trials of urinary incontinence burden the victim.

Bottomley (6) in 1907 reported 8 cases of skin-implantation of the ureters.

TRANSPLANTATION OF THE URETER TO THE BLADDER: URETERO-VESICAL ANASTOMOSIS.—A portion of the bladder wall, conforming as closely as possible to the normal ureteral site, should be utilized for the implantation, i. e. the ureter should enter the bladder as low as possible. Its course through the muscular wall should be oblique. Its orifice should open obliquely through the mucous membrane. A puncture wound through the bladder wall for the implantation brings about an approximation to a vicious right-angled kink of the ureter, so that constriction of the orifice by contraction is almost inevitable. A sound or clamp passed into the bladder cavity through the urethra or through the open bladder, as the case may be, is pressed against the inner wall at the site selected for the anastomosis upon the lower part of the lateral or posterior wall, which has been freed extraperitoneally by dissection and which the proximal extremity of the ureter will reach without traction. An incision 2 to 3 cm. in length is then made along the course which the ureter is to take through the muscular wall of the bladder down to the mucous membrane. The deepest part of this incision is its lowermost point, and the upper part should shelve out to the outer surface of the muscular wall. The mucous membrane is punctured at the lowermost (anterior) ex-

tremity of this incision. The proximal extremity of the ureter which is to be implanted must be freed from the surrounding tissues for 6 to 8 cm. The orifice of the ureter is split at one point for about $\frac{1}{2}$ cm., and a suture of fine catgut (not silk) is passed from the outer to the mucous surface of this now flared portion and back again from the mucous to the outer surface of its wall. A full curved needle should be put upon each end of this suture, which is to serve as a tractor. The needles are passed through the opening in the mucosa of the bladder wall separately and made to penetrate the wall of the bladder at a point $\frac{1}{2}$ cm. below and $\frac{1}{2}$ cm. to each side of the opening, and the ends of the suture are tied upon the outer surface of the bladder. Now the ureter has been brought to lie in the furrow cut in the muscular wall of the bladder, which is sutured, not too snugly, over it with interrupted stitches of fine catgut, chromic gut or silk, 2 or more of which are passed through the outer coats of the ureter itself, to secure it in this situation. This suture line may be covered in by a second row of interrupted stitches, bringing folds from either side together over it.

When the bladder has been opened low down upon the lateral or posterior aspect in resection, the ureter may be implanted in the lower extremity of a suture line by adapting the preceding method to the conditions presented.

When intraperitoneal ureterovesical anastomosis is made, the course of the ureter should be entirely covered by peritoneal flaps. When expeditious anastomosis is demanded, the ureter may be split to form 2 flaps and a suture passed into each flap with a needle on each end of each suture. These are passed into a stab wound in the bladder wall upon a sound and the needles passed within the wound and from within out through the bladder wall, so that a flap is brought to lie against the mucous membrane of the bladder cavity on each side of the new-formed orifice. Then 2 or 3 stitches hold the ureter to the outer surface of the bladder. These sutures should be of silk for security.

This operation may be rapidly completed. Its immediate results have been excellent, but the probability of remote ill effect upon the ureter and kidney makes it undesirable.

The number of recorded cases of ureterovesical anastomosis is now large. Bovee (7) in 1900 collected 80 cases with but 2 failures and less than 1 per cent. mortality.

TRANSPLANTATION OF THE URETER TO THE INTESTINE: URETERO-INTESTINAL ANASTOMOSIS.—Many of the features of this means of diverting the kidney's secretion have been considered under the subject of Exstrophy of the Bladder, to which the reader is referred. The methods for leading the ureter or both ureters to the intestine have been multitudinous. Those which appear to be best and to have stood the test of trial with successful results will be selected for description.

Through the records of Krynski, Martin, Fowler, Stiles, Coffey, Oppel, and others whose work has been similar in establishing a course and termination for the ureter which resemble the normal, we have the most favorable

results and hence the most promising outlook for that method of transplanting the severed ureter which shall give immediate and remote results comparable with transplantation of the entire vesical ureter mouth as in the Maydl and Peters methods.

The mortality of the Maydl procedure is high, but the mortality of implantation of both the severed ureters has been still higher. The record, however, of the yet small number of cases in which the ureter has been implanted according to the plan of the Witzel gastrostomy gives hopeful promise, as in the Martin, Coffey or Stiles methods through which regurgitation into the ureter is possibly prevented, a valve-like orifice is formed and the ureter is secured by careful suture. If, then, the vesical orifice of the ureter is not available for the transplantation, if the ureter cannot be repaired in continuity, or if the vesico-ureteral anastomosis cannot be done, a choice must be made between the skin and the intestine for the ureteral outlet. The opening upon the skin may be controlled by constant surgical care, by dilatation, if necessary, and by the fitting and refitting of appliances for catching the urine as it escapes and wearing (*ad mortem*) a portable urinal. Experience with urinary fistulæ has driven some patients and many surgeons to choose the intestinal anastomosis in preference to the skin anastomosis.

The method described is practically that of Martin, Coffey and Stiles (37). It is the procedure for the severed ureter. For the ureter with a rosette of vesical mucosa about the ureter mouth, the Peters method is described under *Exstrophy of the Bladder*.

When the severed ureter is found by extraperitoneal approach and the ureter is of sufficient length to be implanted into the rectum, this part of the intestine should be employed by stripping the peritoneum from its upper part. When the severed ureter is not found extraperitoneally or is too short to be implanted so low in the pelvis, it must be sought through the peritoneal cavity, behind the posterior parietal peritoneum, as it crosses the bifurcation of the common iliac artery or in its course above this point. Divide the parietal peritoneum over the course of the ureter and without injury to its vessels dissect it free and bring it into the wound, protecting surrounding tissues from the escaping urine. Pass a clamped or occluded small rubber or ureteral catheter into its lumen and ligate its very extremity about this to prevent further escape of urine. The ureter may be occluded by a weak spring clamp, but this presents danger of permanently occluding its vessels, which may be important for the nourishment of the implanted portion. The passing of the suture through the extremity of the ureter can be easily done with the catheter in place and its orifice can be split upon the catheter when dividing the ligature just before passing it into the gut. Care must be taken, as the ligature is divided and the catheter is removed, that all escaping urine—a gush perhaps—is caught on gauze or in a sterile cup. Do not remove the clamp from the catheter. Pass a traction suture of catgut (not silk) carrying a needle on each end through the extremity of the ureter and split the ureter for $\frac{1}{2}$ to $\frac{3}{4}$ cm.

from its extremity at 1 point only. This traction suture at the extremity may be tied about the flared-out end to give greater security, avoiding its cut-

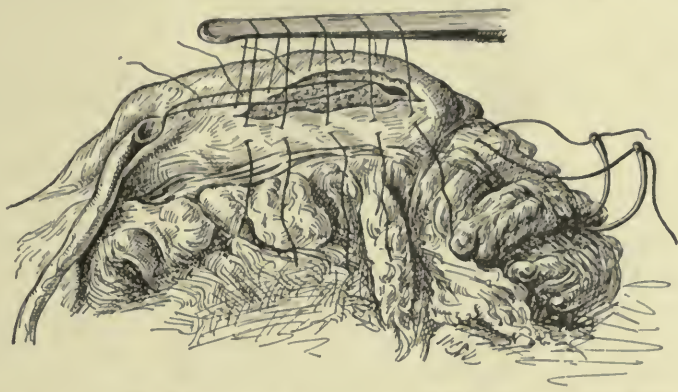


FIG. 35.—COFFEY METHOD OF IMPLANTING URETER IN LARGE INTESTINE.

ting or tearing out. Place a curved, rubber-covered, intestinal clamp upon an emptied part of the lowermost portion of the pelvic colon (sigmoid or rectum).

By an incision transverse or oblique to its long axis, divide the peritoneal and muscular coats of the intestine without opening the mucosa. At the lowermost point of this incision make a very small puncture in the mucosa. Pass the needles upon the traction



FIG. 36.—COFFEY METHOD.

suture attached to the ureter through this small orifice into the gut, and transfix the intestinal wall from within out at a point $\frac{1}{2}$ to 1 cm. below the opening

and the same distance *from each other*. By drawing on these sutures through the gut wall and manipulating the ureter with a probe, its end is made to pass through the hole in the intestinal mucosa, and the ureter lies in the groove of the incision through the muscular wall.

Tighten the ends of the traction suture, tie them on the outer surface of the gut,



FIG. 37.—COFFEY METHOD. Completion of suturing.

and cover this knot with peritoneum by a Lembert suture or 2. Fix the ureter in its groove on the Witzel gastrostomy plan by interrupted sutures of

fine silk or Pagenstecher, some of which catch the outer tissues of the ureter wall. A second layer of sutures may be used to cover in the first suture line. Close the peritoneum opened to reach the ureter in the pelvis up to and about the ureter. Suture the peritoneum about the ureter from its entrance to the peritoneum to where the ureter passes into the intestinal wall. A drain of rubber tissue may be passed from the point of anastomosis out through the abdominal wound.

Stiles reports 2 cases (1911), 3 years after operation, with excellent recovery and continued good health; no evidence of renal infection; urine voided per anum every 3 to 6 hours; bowels normal. Oppel reports 19 cases, i. e., 38 ureteral transplantations, by the Mirotworzeff method. Mayo (C. H.) reports 4 cases by the Coffey method without mortality. Mirotworzeff reports 6 cases; 2 for advanced carcinoma were relieved from pain but died of malignant neoplasm; 1 died as result of operation, 3 cases are living in good condition.

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3

OPERATIONS ON THE URETHRA FOR STRICTURE AND
ACQUIRED DEFECTS

CHAPTER III

OPERATIONS ON THE URETHRA FOR STRICTURE AND ACQUIRED DEFECTS

DAVID GEIRINGER

Operations upon the urethra include meatotomy, internal and external urethrotomy, combined internal and external urethrotomy, and the various plastic operations for repairing defects of the urethra due to disease or trauma.

MEATOTOMY

This minor operation is performed perhaps more frequently than any other operation in genito-urinary surgery.

Indications.—Meatotomy is indicated in the following conditions:

1. In congenital stricture of the external urethral orifice when the meatus is so small that it interferes with urination or causes urethral or prostatic irritation because of the back pressure exerted on the urethral walls.
2. In cases in which the meatus is so small that it will not permit the passage of instruments for examination or treatment of the urethra, prostate, bladder, or kidneys.

There is no fixed guide for the size of a normal meatus. As a rule, it corresponds with the size of the penis. In a general way, the meatus need not be cut unless it is so small that it interferes with urination or gives rise to urethral irritation, evidenced by frequent and painful urination, other causative factors being excluded. One frequently sees a small meatus which causes no urinary difficulties.

The contraction is usually found at the meatal orifice. Occasionally, however, constricting bands are present a quarter of an inch behind the meatus or just behind the fossa navicularis. The following 4 types of contracted urethral outlets are encountered:

1. Small meatus due to a fold of mucous membrane projecting upward from the floor of the urethra (Fig. 1).
2. In addition to a narrow meatus, postmeatal constricting bands are present (Fig. 2).

3. A small culdesac may be present in the roof of the fossa navicularis, with a small meatus below. Occasionally the culdesac opens into the urethra beyond (Fig. 3).

4. A small meatus is frequently found in penile and balanic hypospadias (Fig. 4).

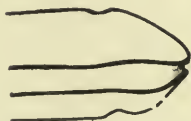


FIG. 1.—CONTRACTED MEATUS. (Original.)



FIG. 2.—POSTMEATAL CONTRACTION. (Original.)



FIG. 3.—NARROW MEATUS WITH SMALL CULDESAC IN ROOF OF FOSSA NAVICULARIS. (Original.)



FIG. 4.—CONTRACTED HYPOSPADIAC MEATUS. (Original.)

Instruments Required.—Blunt-pointed bistoury.

Urethral speculum.

Grooved director.

Hypodermic syringe.

Glass urethral syringe.

Alypin or novocain solution 4 per cent., or 2 per cent. cocain.

Silver nitrate solution 1:4,000.

Bichlorid of mercury 1:3,000.

Urethral sounds.

Olivary bougies.

Technic.—The parts are first washed with green soap and water followed with bichlorid 1:3,000. The anterior urethra is anesthetized by injecting 4 per cent. alypin with the glass syringe. To insure perfect anesthesia, a few drops of the same solution are injected with a hypodermic syringe into the floor of the urethra just behind the meatus, forming a small wheal on the under surface of the glans (Fig. 6).

The urethral speculum is then inserted and the blades opened, putting the meatus on the stretch. An incision is made in the floor of the urethra directly in the median line (Fig. 7). All constricting bands behind the meatus should likewise be divided. The speculum is then withdrawn and the patency of the canal tested with an olivary bougie. If 31 French is admitted, the operation is complete. The anterior urethra is irrigated with 1:4,000 silver nitrate solution, after which a plug is introduced to prevent the edges of the wound from growing together. The plug is made by wrapping a small piece of cotton around the end of a smooth tooth-pick. This is dipped into carbolized vaselin or boric acid

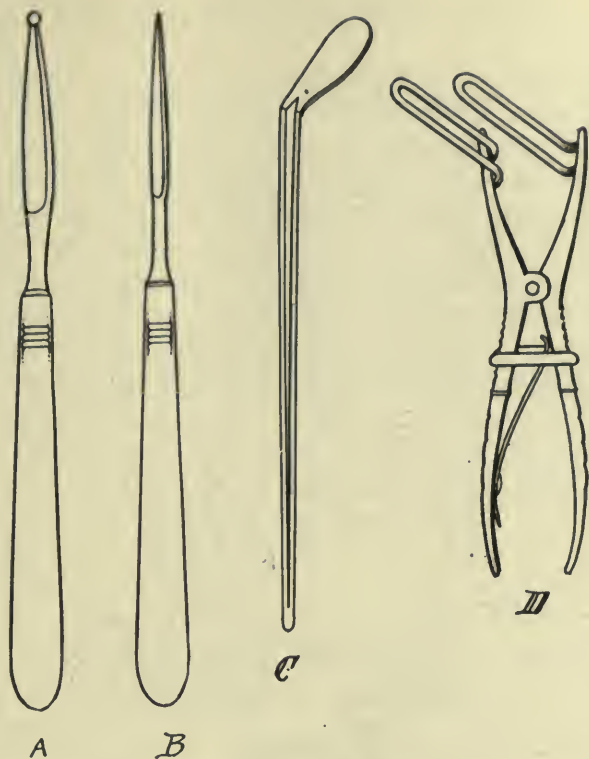


FIG. 5.—INSTRUMENTS REQUIRED FOR MEATOTOMY. A, Blunt-pointed knife; B, sharp-pointed knife; C, grooved director; D, urethral speculum. (Original.)

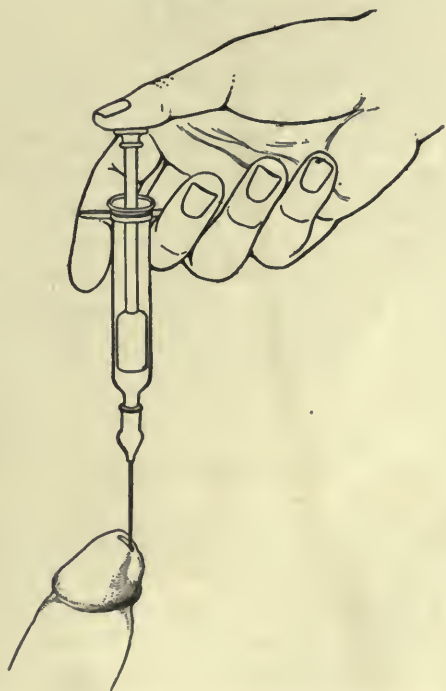


FIG. 6.—SHOWING HOW URETHRA IS ANESTHETIZED.

ointment and inserted into the meatus, after which the tooth-pick is withdrawn leaving the cotton plug in the urethra. Before urinating, the plug is removed and a fresh one inserted afterward. Sounds are passed every other day, until there is no tendency to recontraction. After passing sounds the urethra is irrigated with 1:4,000 silver nitrate solution. After the third day the plug can be omitted.

Hemorrhage sometimes occurs if the incision has not been made in the median line. If severe, a large size woven catheter is inserted into the urethra and the penis bandaged snugly around it. It can nearly always be controlled by inserting a plug which has been dipped in adrenalin chlorid 1:1,000. Immedi-

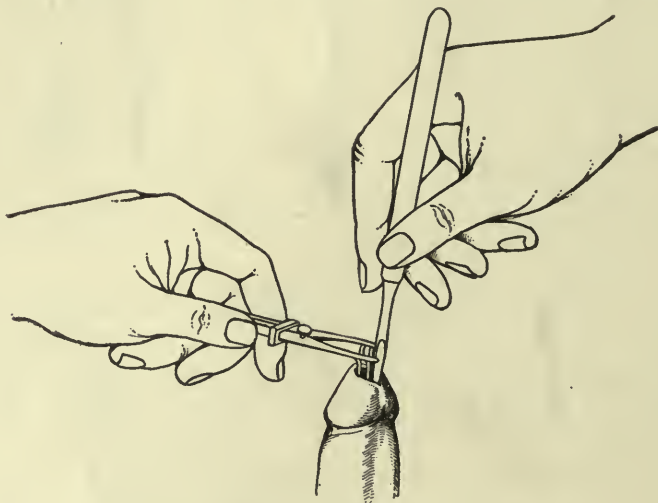


FIG. 7.—SHOWING HOW MEATUS IS DIVIDED.

ately after operation a small amount of blood collects in the urethra behind the plug, which is apt to alarm the patient when he removes the first plug prior to urination. It is well to inform him of this beforehand.

Sometimes the meatus is so small that the urethral speculum cannot be introduced, in which case a grooved director is inserted into the meatus with the groove toward the frenum. The knife is then passed along the groove and the meatus cut sufficiently to admit the speculum, which is then introduced and the operation completed as described above.

URETHROTOMY

If a urethral stricture is divided entirely from within the urethra, the operation is termed internal urethrotomy. If it is divided from without, approaching it by first cutting through the perineal tissues, the operation is called external urethrotomy. When both methods are employed in the same case, the operation is known as combined internal and external urethrotomy.

INTERNAL URETHROTOMY

Indications.—All fibrous, resilient, or irritable strictures which resist dilatation, whether of small or large caliber, should be treated by internal urethrotomy. This operation is limited to strictures in the penile and scrotal urethra.

Contra-indications.—Internal urethrotomy should never be performed when the urethra is acutely inflamed. If due to a recent acute gonorrhea or to an acute exacerbation of a chronic infection, the inflammation must first be reduced by appropriate treatment, in order to render the urethra surgically clean.

This operation is likewise contra-indicated in long-standing tight strictures complicated with a severe cystitis. In such cases external urethrotomy is the operation of choice. If the stricture in this instance is situated anteriorly, it is divided by internal urethrotomy and perineal section performed for drainage.

Instruments Required.—Maisonneuve urethrotome.

Otis urethrotome.

Olivary bougies.

Metal sounds.

Soft rubber and woven silk urethral catheters.

Solution cocain 4 per cent. or alypin 5 per cent.

Solution silver nitrate 1:4,000.

Tincture of green soap.

Bichlorid of mercury solution 1:3,000.

The Maisonneuve urethrotome is used for cutting strictures which are under 15 French in size. When the stricture is of larger caliber, 15 French or more, the Otis instrument is better. The Maisonneuve urethrotome (Fig. 8) consists of a slender metal shaft, 8 to 9 French, shaped like a sound. To its distal end is screwed a fine flexible silk filiform to facilitate the passage of the shaft through the stricture. On the upper or concave side of the shaft is a groove through which the knife is guided in cutting through the stricture. The knife consists of a triangular blade, one side of which is joined to a long, flexible metal handle. The apex of the blade is provided with a dull shoulder, while the 2 sides, sloping downward from the apex toward the handle, have cutting edges.

Preparation of the Patient.—For a week prior to operation the urethra is rendered as aseptic as possible by daily irrigations of silver nitrate 1:4,000 and the internal administration of urotropin, gr. x, 3 times a day. On the night before operation a purge, preferably calomel, gr. iii, is administered, followed by 1½ oz. of magnesium sulphate or 3 oz. of Carabana water, in the morning. The parts should be shaved and a soap poultice applied.

After the patient is brought to the operating room he is instructed to urinate, after which his bladder and urethra are irrigated with warm boric acid solution, 2½ per cent. Eight ounces of the solution are left in the bladder.

If the operation is to be performed under local anesthesia, the urethra is anesthetized by injecting 4 per cent. cocain or 5 per cent. alypin solution. To insure perfect anesthesia the solution is held in the urethra for at least 10

minutes. If the stricture is tight, or if several strictures are present, a general anesthetic should be given, especially if the patient is nervous or apprehensive.

Technic of Internal Urethrotomy with the Maisonneuve Urethrotome.—The surgeon, standing on the patient's left, steadies the penis with the left hand and introduces the filiform guide into the urethra through the stricture into the bladder. The metal shaft of the urethrotome is then screwed to the filiform guide and made to follow it through the urethra into the bladder. Having introduced the instrument, the surgeon holds the shaft at right angles to the body, steadying the instrument by holding the proximal end of the handle between the thumb and forefinger of the left hand. An assistant holds the penis slightly on the stretch. Before inserting the knife, the surgeon should see that

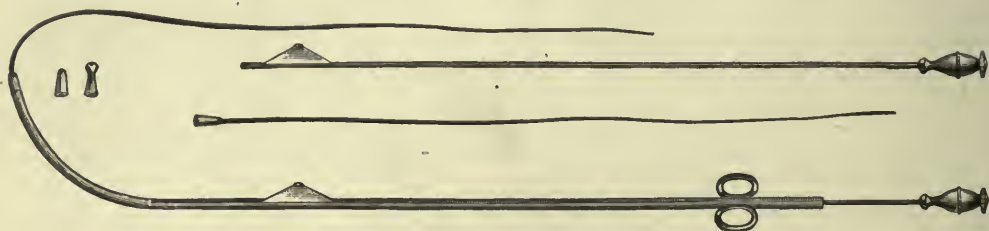


FIG. 8.—MAISONNEUVE URETHROTOME.

the groove of the instrument points to the space between the corpora cavernosa in the median line. The knife is then inserted into the groove and slowly advanced into the urethra until the stricture is reached, when resistance will be felt. A slight push divides the stricture. If another stricture is present, it is similarly divided. The knife is then withdrawn, and then the shaft, after which olivary bougies are passed to determine the size of the urethra. Usually the stricture has been cut to 18 or 20 French. It is then cut to a still larger size with the Otis urethrotome.

The Maisonneuve urethrotome is provided with knives of different sizes. It is best, however, to use only the smallest knife, because if the stricture is tough or resistant, the force required to push the larger knife through the stricture may tear the urethra or corpus spongiosum and even the corpora cavernosa as well, giving rise to troublesome hemorrhage and sometimes causing traumatic stricture. If, after cutting the stricture with the smallest knife, further division is necessary, it is best to complete the operation with the Otis urethrotome.

Technic of Internal Urethrotomy with the Otis Urethrotome.—The Otis urethrotome (Fig. 9) is a combined dilating and cutting instrument. It is the most suitable instrument for dividing strictures of larger caliber, 15 French or over. The shaft consists of 2 slender parallel steel rods fastened together at both ends. By turning a screw situated at the handle end, the 2 rods are made to separate. A dial, graduated in millimeters, registers the amount of dilatation. On the dorsum of the shaft is a groove through which the knife is guided. The groove is so constructed that when the knife is passed through it the blade is exposed until the distal end of the instrument is reached, when it disappears

from view. The knife blade is small and is fixed to the end of a slender, flexible metal rod.

The patient is prepared, as previously described. The location of the stricture having previously been noted, the Otis instrument lubricated with vaselin is passed into the urethra until its tip is an inch below the stricture. Before introducing the instrument the knife is inserted into the groove and pushed toward the end of the instrument until its cutting edge is hidden.

The instrument having been introduced into the urethra, an assistant holds the penis on the stretch. The surgeon, holding the instrument at right angles to the body, turns the wheel and dilates the instrument up to the size of the stricture. The stricture should not be forcibly dilated as rupture of the urethra may occur. Just enough dilatation to put the stricture on a stretch is sufficient. The knife blade is then drawn upward far enough to cut the stricture, after which it is pushed back into its hiding place. If any other strictures are present, they are similarly divided. If several strictures are present, the smallest one should be cut first, after which the instrument is closed and withdrawn. Olives are then passed to determine the size of the urethra. If an obstruction still exists, its location is noted. The urethrotome is again introduced

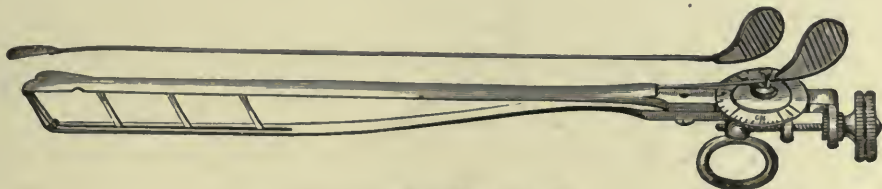


FIG. 9.—OTIS URETHROTOME.

and the narrowing divided. When the urethra easily admits a 31 French sound, the operation is complete. The anterior urethra is then irrigated with 1:4,000 silver nitrate solution through a soft rubber catheter. (Until the canal admits a full-sized bulb without lumps, there is still scar tissue requiring division.—EDITOR.)

After-treatment.—The patient should remain in bed for 3 days. On the first day after operation the anterior urethra is irrigated with 1:4,000 silver nitrate solution. On the second day sounds are passed, followed by irrigations of silver. Thereafter sounds should be passed every 2 days, followed by irrigations with silver nitrate solution, beginning with 1:4,000 and gradually increasing in strength. If either 4 per cent. alypin or 2 per cent. eocain is injected into the urethra prior to instrumentation, very little discomfort will be experienced by the patient. If difficulty is encountered in passing sounds or if bleeding is caused, the urethra should first be slowly dilated with an Oberlaender dilator. Urotropin, gr. x, 3 times a day, is given for 1 week following operation. If gonococcal infection is present, the patient is given a hand in-

jection of protargol 1:200. When the gonococci disappear, an astringent injection of the following type is useful:

℞ Zinc sulphat	grs. vi	36
Alum	grs. vi	36
Glycerin	oz. ss.	15
Water ad	oz. iv	120

Complications.—1. SEVERE HEMORRHAGE sometimes follows. This is controlled by a snug-fitting bandage placed around the penis, or by introducing a large size woven catheter or metal sound and bandaging the penis firmly around it.

2. SEPSIS occurs but rarely and is usually due to lack of aseptic care in arresting hemorrhage after operation.

Results.—If properly performed in suitable cases, internal urethrotomy gives excellent results. A fatal outcome is rare and in the few cases recorded was due to lack of asepsis in the measures employed to stop severe hemorrhage following operation.

If excessive dilatation is employed during the operation, or if the knife has been too forcibly pushed through the stricture, scar tissue sometimes forms, causing the organ to bend during erection as in chordee. This deformity, unless very marked, usually slowly disappears.

(Such curvature may last for months, or even a year, but is never permanent in my experience. It may be treated by massage of the penis over a sound, the urethra being drawn up on the sound so as to put it on the stretch. An indifferent oil or grease may be used on the skin. Dr. F. N. Otis used skunk oil for this purpose and esteemed it highly.—EDITOR.)

EXTERNAL URETHROTOMY

This operation consists in opening the perineal urethra through an incision made in the median line of the perineum.

Indications.—1. Strictures in the deep urethra which are so dense and unyielding that they cannot be dilated or are so resilient that they contract immediately after dilatation.

2. Impassable stricture.

3. Stricture complicated by

a. Extravasation of urine.

b. Perineal or peri-urethral abscess.

c. Fistulæ.

d. Attacks of retention.

e. Chronic cystitis so severe that it cannot be relieved by treatment, in which case operation by perineal section is indicated for drainage.

The method of operating depends on the type of stricture and its location; thus, if an instrument can be passed through the stricture into the bladder,

external urethrotomy with a guide is performed; if the stricture is impassable, then external urethrotomy without a guide is done.

Preparation of the Patient.—If the stricture is permeable and there is no urgent cause for immediate operation, the urethra and bladder should be irrigated every day for 1 week prior to operation with 1:4,000 silver nitrate solution. Urotropin, gr. x, should be taken internally, 3 times a day. On the night before operation a purge is given consisting of 3 gr. calomel followed by $\frac{1}{2}$ oz. magnesium sulphate the next morning.

The field of operation, which includes the pubes, external genitals, the



FIG. 10.—GOULEY TUNNELED SOUND AND GUIDE.

perineum, and the adjacent portions of the thighs, is prepared in the routine way by shaving, soap poultice, and sterile gauze dressing. The soap poultice is quite irritating to the scrotum and should not be left in place for more than 3 hours.

The patient should not be allowed to void for 6 hours prior to operation. That is especially important when the stricture is impassable, as it is much easier to operate when the bladder is full. In these cases when trouble in entering the bladder is anticipated, it is wise to tie a bandage around the penis to prevent the patient voiding while he is being anesthetized.

The patient is placed upon the table lying at full length and is anesthetized

with gas and ether. In scrubbing the field of operation, special care should be taken to thoroughly clean the preputial cavity. If the stricture is passable, the urethra and bladder are irrigated with borie acid solution. About 8 oz. are left in the bladder, as this helps the operator to determine when he has entered the bladder.

Instruments Required.—As the term “guide” is frequently used in describing the operation of external urethrotomy, its meaning should be perfectly understood by the reader. Any instrument introduced into the urethra for the purpose of aiding the operator to more easily identify the canal when approaching it through the perineum is called a guide. The Gouley tunneled sound and

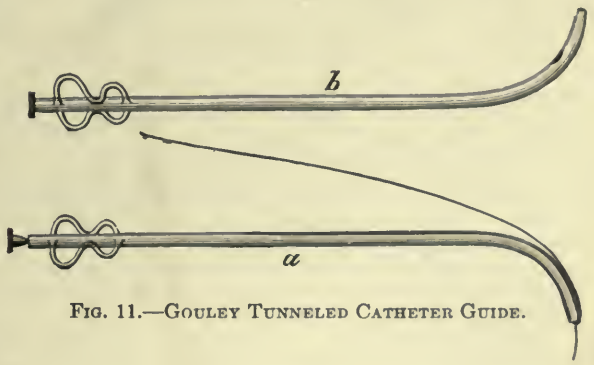


FIG. 11.—GOULEY TUNNELED CATHETER GUIDE.

catheter are the instruments most frequently used as guides (Figs. 10, 11). The former consists of a curved steel sound grooved on the convexity. Its distal extremity is provided with a small tunnel for threading the sound over a filiform. The Gouley tunneled catheter guide consists of an ordinary metal catheter and stylet, grooved on the convexity and similarly provided with a small

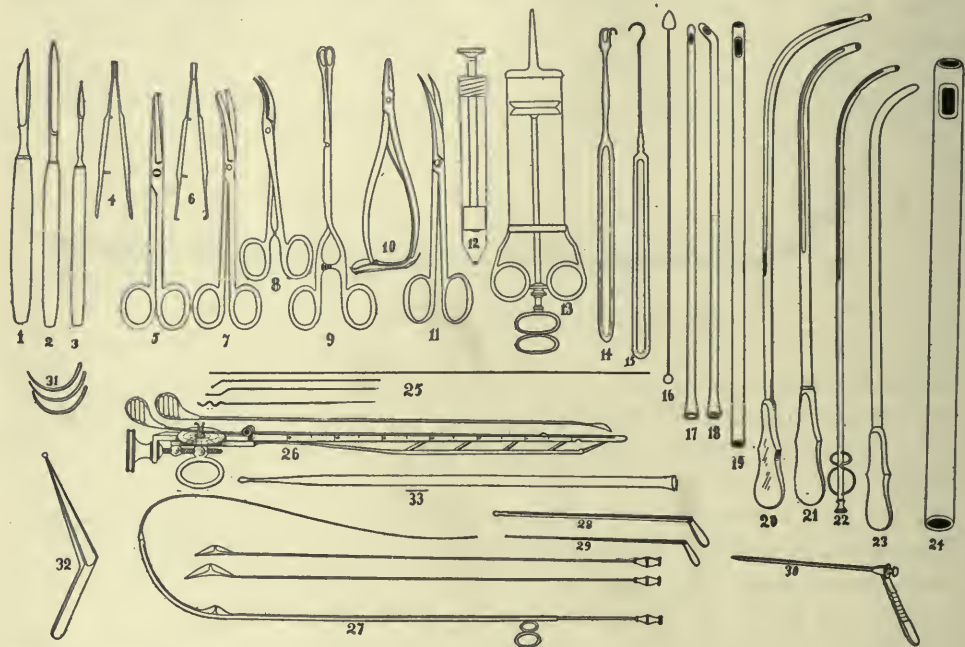


FIG. 12.—INSTRUMENTS FOR OPERATIONS ON URETHRA. (Guiteras.) 1, Scalpel; 2, straight bistoury; 3, Gouley's beaked bistoury; 4, thumb forceps; 5, straight blunt pointed scissors; 6, mouse-tooth thumb forceps; 7, curved blunt pointed scissors; 8, artery clamp; 9, sponge forceps; 10, needle holder; 11, curved sharp pointed scissors; 12, small hand syringe; 13, large hand syringe; 14, perineal retractors; 15, tenaculum; 16, bougies à boule; 17, straight catheter; 18, coude catheter; 19, straight catheter with openings on end and side; 20, Guiteras tunneled lithotomy guide; 21, Gouley tunneled sound; 22, Gouley tunneled catheter; 23, metallic sounds (Otis curve); 24, perineal drainage tube; 25, filiforms, straight, angular and spiral; 26, Otis urethrotome; 27, Maisonneuve urethrotome with knives of different sizes; 28, perineal probe pointed grooved director; 29, perineal grooved probe; 30, Guiteras perineal grooved cannula; 31, round curved needles; 32, gorget; 33, olive-pointed woven silk bougies.

tunnel at the distal end. Occasionally the stricture is so tight that only a filiform can be passed through it. In such cases the filiform is the guide upon which the urethra is opened. In addition to the guides, the instruments shown in Figure 12 are used.

Examination at the Time of Operation.—After the patient is anesthetized, the surgeon examines the urethra with the *bougies à boule* to determine more definitely the nature, size, and location of the obstruction. If the stricture is passable, admitting a No. 6 or 8 French bougie, a Gouley tunneled sound or catheter of corresponding size is passed into the bladder and the operation performed on a metallic guide which has been passed into the bladder (Fig. 13).

(As we receive bad cases of urethral strictures in the hospital, the diagnosis is usually self-evident. In such cases, unless retention, unrelieved by hot baths, etc., exists, the examination of the urethra may well be deferred until the time of operation. In this way certain fatal cases of septicemia may be avoided.—EDITOR.)

Position of the Patient, Operator and Assistants.—Having inserted the guide, the patient lies upon his back, with his thighs and knees flexed at an acute angle.

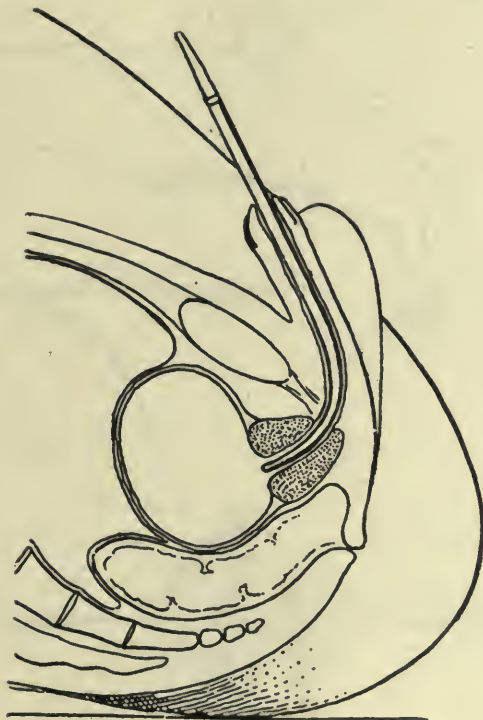


FIG. 13.—EXTERNAL URETHROTOMY WITH GUIDE WHICH HAS PASSED THROUGH STRICTURE INTO BLADDER. (Guiteras.)

His limbs are held in this position by lithotomy uprights or by Clover's crutch. The instruments, previously sterilized, are placed within easy reach of the operator, who seats himself facing the patient's perineum. An assistant stands on either side of the patient. The first assistant, on the patient's left, holds the metallic guide with his right hand. With his left hand, which is under the patient's leg, he assists the operator.

Technic of External Urethrotomy with a Guide.—The first assistant presses the guide downward against the perineum. The operator, raising the scrotum with the left hand, makes a vertical incision in the median line about 2 in. long, beginning just behind the scrotum and ending about $\frac{3}{4}$ in. in front of the anus. (The assistant may hold both the scrotum and guide.) The subcutaneous tissues and fascia are divided until the fibers of the accelerator

urinæ muscles are reached (Fig. 14). Occasionally small vessels are cut, which should be tied before proceeding. The sides of the incision are then retracted. The bulb is freed by blunt dissection from the overlying tissues, after which it is lifted toward the pubes with a sharp retractor. The finger is then inserted into the wound and the groove of the metallic guide felt for behind

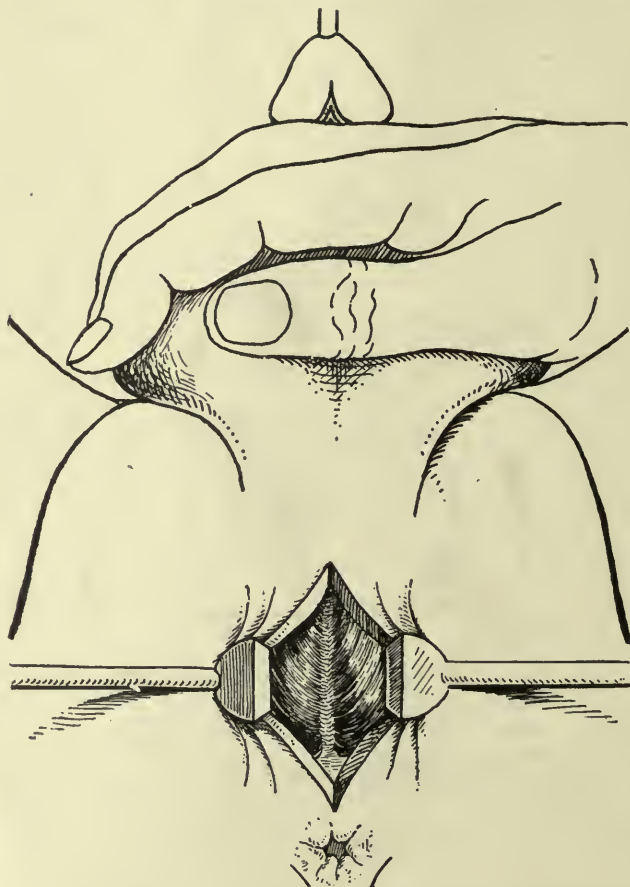


FIG. 14.—SHOWING SKIN INCISION RETRACTED. The two layers of the superficial fascia have been cut through. The fibers of the accelerator urinæ muscles are seen. (Guiteras.)

the bulb. Having located the guide, an incision is made through the urethra down to the groove of the guide. This incision should be made from above downward and is about $\frac{1}{2}$ in. long. Having made the incision through the urethra at this point, the knife point is directed upward toward the meatus to divide any remaining strictured portions of the urethra (Fig. 15). Although the incision through the urethra is preferably made just behind the bulb, incision into the bulb is entirely harmless. In fact, the urethra is more frequently incised in the bulbous than the membranous portion.

The perineal grooved director is then inserted through the perineal wound

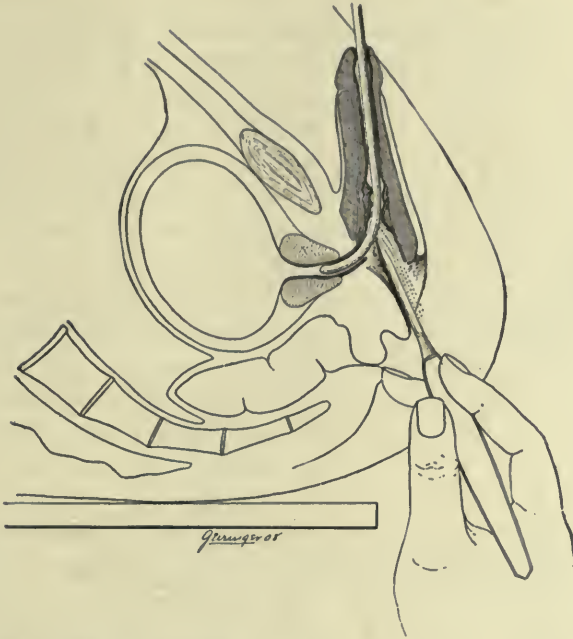


FIG. 15.—THE KNIFE TURNED AND PUSHED UP ALONG THE GROOVE IN THE GUIDE IN ORDER TO CUT ANY STRICTURED PORTION JUST ABOVE THE INCISION. (Guiteras.)

and passed along the guide into the bladder. The guide is then withdrawn, leaving the director in the bladder. The operator passes his forefinger along

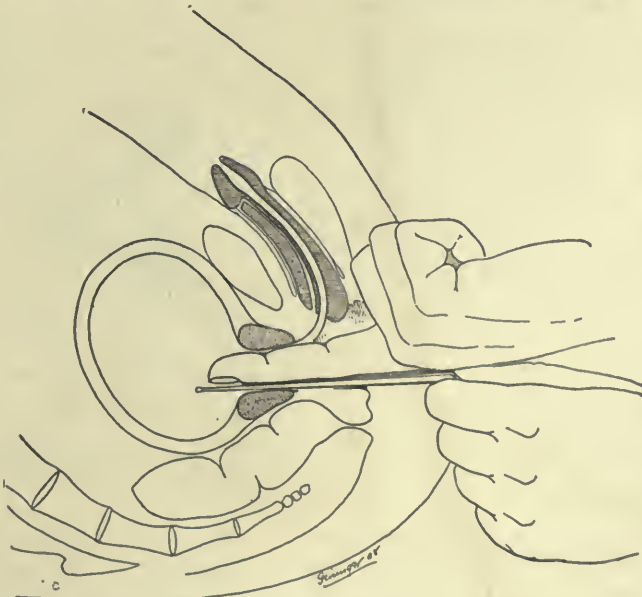


FIG. 16.—THE PERINEAL GROOVED DIRECTOR INSERTED ALONG THE GUIDE INTO THE BLADDER; THE FINGER PASSED ALONG IT INTO THE BLADDER. (Guiteras.)

the director into the bladder (Fig. 16). The tight margin of the cut-off muscle is first felt, and through this the finger is gently but firmly pressed, passing into the prostatic urethra, which is then palpated. The neck of the bladder is next encountered. This has a characteristic feel, being soft and velvety, and exerts a mild uniform pressure which gradually relaxes as the finger passes through. The bladder is then explored for any pathological conditions.

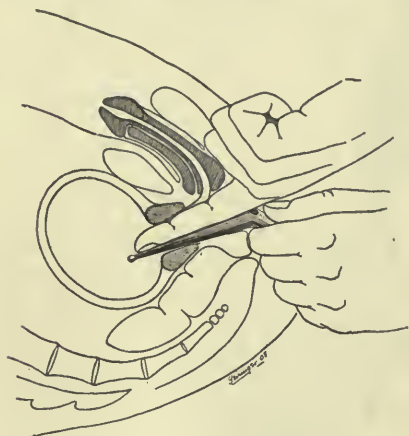


FIG. 17.—EXPLORATION OF THE INTERIOR OF THE BLADDER WITH THE FINGER; THE GORGET BEING PASSED ALONG IT INTO THE BLADDER. (Guiteras.)

Before completing the operation, the roof of the urethra should be examined with the finger, to be sure that no scar tissue is left. If any bands or lumps of scar tissue are felt, they are divided or excised.

A gorget is then passed through the perineal incision into the bladder, and the finger passed along it into the bladder to make sure that the passage is clear (Fig. 17). The gorget being held in place by an assistant, the operator passes sounds

through the urethra into the bladder. False passages, if present, are divided.

After sounds up to 31 French have been passed, the perineal tube is introduced through the perineal wound into the bladder and the gorget withdrawn (Fig. 18). The urethra is flushed out with boric acid solution, after which the bladder is irrigated through the tube with the same solution. The perineal tube is then drawn out until its eye is just within the bladder. If the tube projects too far into the bladder, it presses against the vesical wall, causing pain and spasm. If the bladder is filled and the tube is drawn out until it no longer drains and then is pushed slowly back until it drains again, the end of the tube will lie just within the bladder. The tube is fastened in position with adhesive plaster or tape, or by means of a large safety-pin which includes the tube and both edges of the wound. The perineal incision is then closed around the tube with 3 or 4 sutures of chromic catgut No. 2 (Fig. 19).

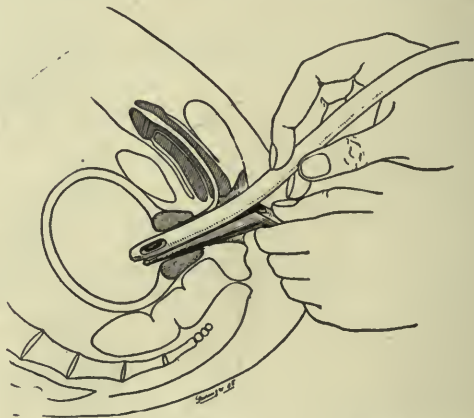


FIG. 18.—THE PERINEAL DRAINAGE TUBE BEING PASSED ALONG THE GORGET, INTO THE BLADDER. (Guiteras.)

A large combined dressing is placed on either side of the perineal tube and a T-bandage is firmly applied, exerting pressure against the perineum. In cases with tortuous stricture, ruptured or deformed urethra, a catheter is inserted into the urethra as far down as the perineal tube. (The tube should be large, 30 French. To hold it in place, I have for many years surrounded it with a section of soft rubber tubing, about $\frac{3}{4}$ in. in length, so placed that the end of the drainage tube just draws water when the sleeve is at the skin level. The sleeve is then sutured with a single heavy silk stitch to both sides of the perineal wound.—EDITOR.)

Difficulties of Operation.—External urethrotomy with a guide is a comparatively simple operation, but in cases with tight, tortuous, or impassable strictures, the operation often becomes exceedingly difficult. The method of operating will depend upon the conditions found on examination.

1. If the stricture is tight, allowing only a filiform to be passed through it into the bladder, a small-sized Gouley tunneled sound or catheter should be threaded over it and an attempt made to enter the bladder. If the bladder has been entered, urine or the boric acid solution will escape when the stilet is withdrawn. The operation can then be performed on a guide as in the first instance. If no urine escapes, it signifies that the instrument has not entered the bladder but lies either in the membranous or prostatic urethra, or perhaps just in front of the cut-off muscle. In this case, perineal section is performed on a guide which has passed through the stricture but not into the bladder.

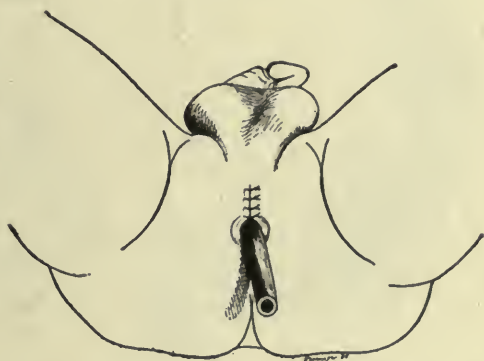


FIG. 19.—THE PERINEAL WOUND CLOSED WITH INTERRUPTED SUTURES DOWN TO THE TUBE; THE TUBE HELD IN POSITION WITH A SAFETY PIN WHICH PASSES THROUGH BOTH EDGES OF THE WOUND. (Guiteras.)

Having incised the urethra through the perineal incision, the grooved director is passed along the guide into the bladder. If it gets caught and does not enter, the perineal probe, being more flexible, easily adapts itself to any turns in the posterior urethra and enters the bladder. The operation is then completed as previously described.

2. If the tunneled catheter cannot be passed over the filiform through the stricture, it should be passed down as far as possible, in which case, the operation is performed on a guide the end of which lies in the perineal urethra in front of the stricture.

The urethra is incised in the groove near the end of the guide, after which retraction sutures are passed through both sides of the urethra and the field of operation freely exposed. If the incision into the urethra has divided the stricture, the guide can be made to follow the filiform into the bladder. If the

stricture has not been divided, the blunt-pointed knife should be passed into the urethra and the stricture cut from above downward, following which the guide can usually be passed into the bladder over the filiform. If the guide cannot be made to enter the bladder, the filiform should be grasped by an artery clamp and steadied so that it will not slip out of the bladder. Its proximal end is then pulled through the anterior urethra from below, so that it will project

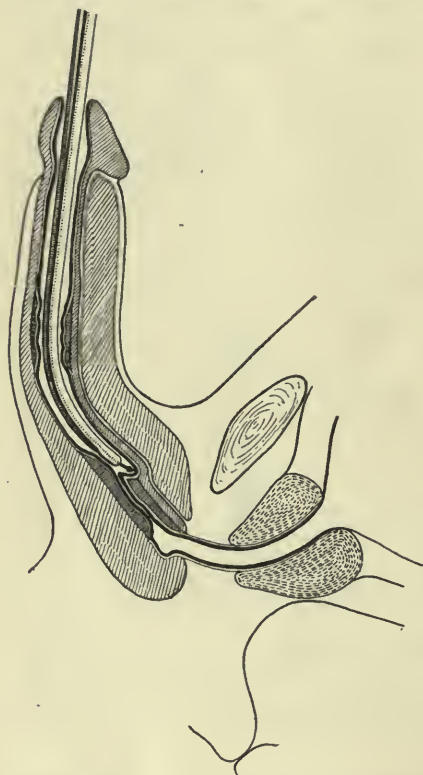


FIG. 20.—SHOWING IMPASSABLE STRICTURE IN BULBOUS URETHRA. The guide is passed down to the anterior wall of the obstruction. (Guiteras.)

through the perineal incision. To give more room, the guide is turned so that its beak projects out of the wound. The grooved probe is then passed along the filiform into the bladder, after which it is turned, groove pointing downward, and a blunt-pointed knife passed along it, dividing any uncut strictured portions. The operation is then completed in the usual way.

3. If the stricture is situated in the scrotal or pendulous urethra and only a filiform can be passed through it into the bladder, the incision through the skin and overlying tissues is made as previously described, until the bulb is exposed. The operator should proceed with caution exactly in the median line and carefully cut through the urethra, exposing the filiform. A slender dull-pointed knife is then passed upward through the urethra and the stricture divided. The operation is completed as previously described.

4. If the stricture is in the bulb and it is impossible to pass even a filiform through it, the tunneled sound should be passed as far down the urethra as the stricture will permit (Fig. 20). The urethra

should then be opened over the end of the guide. Retraction sutures are passed through the urethra on either side. The guide is turned so that its end projects out of the wound. All bleeding points are ligated and oozing, if excessive, is controlled by a hot sponge held in the wound. The surgeon then attempts to pass either a grooved probe or filiform into the bladder. If a number of openings are seen, he should probe each one in turn, being careful to hug the roof of the urethra. If unsuccessful, the incision should be enlarged, splitting the strictured tissues by cutting in a downward direction.

Very often, after probing several openings unsuccessfully, by pushing the probe downward along one side of the canal where no opening is apparent, the

instrument glides easily into the bladder. If the probe or filiform passes through into the bladder, a thin-bladed knife is passed along its groove and any remaining strictured tissues divided. If the probe does not enter, but the filiform does, the probe can usually be made to enter alongside of it. Sometimes a small tunneled catheter can be threaded over the filiform and passed over it into the bladder.

The operator should bear in mind that reckless cutting of the urethra and perineal tissues in these cases may be followed by pelvic infection, septic phlebitis of the prostatic plexus, or injury to the rectum. If unsuccessful in

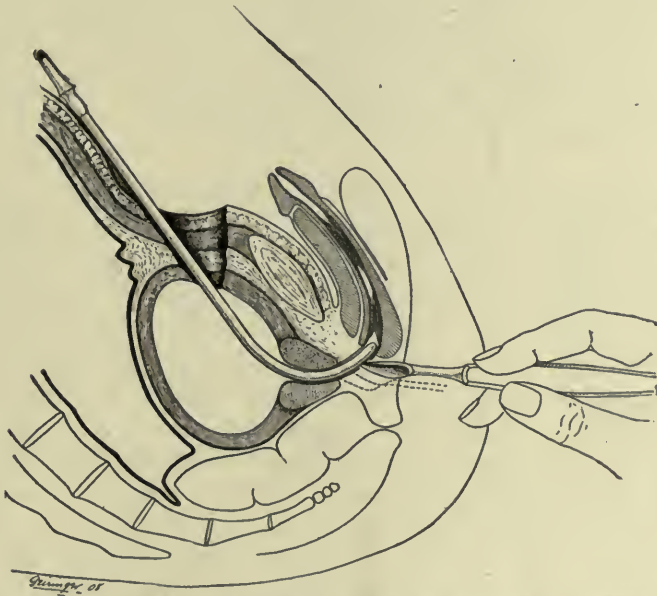


FIG. 21.—SUPRAPUBIC CYSTOTOMY PERFORMED IN CASE OF FAILURE TO EFFECT AN ENTRANCE INTO THE BLADDER; A GUIDE PASSED THROUGH THE SUPRAPUBIC OPENING INTO THE PERINEAL URETHRA AND THE URETHRA INCISED OVER IT. (Guiteras.)

entering the bladder, a suprapubic cystotomy can always be performed and a grooved sound passed from above through the bladder and a direct incision made upon it through the perineal opening (Fig. 21). (Haste in these cases is never wise. Patience, gentleness, perseverance, and sterile oil will do more toward success than impatience and violence, as in other historic situations.—EDITOR.)

5. If the stricture is impassable and is situated at the penoserotal junction or anterior to it, then the operation must be performed without a guide. This last often proves a very difficult procedure, requiring at times suprapubic cystotomy with retrograde catheterization. Before resorting to operation without a guide, the operator should make every effort to find the opening of the stricture and pass an instrument through it. This may be accomplished by inserting a direct view irrigating urethroscope into the urethra down to the

stricture. After distending the urethra with water, the opening of the stricture is seen and one is often able to pass a filiform through it. An attempt should then be made to pass a tunneled catheter guide over it into the bladder. If unsuccessful, the operation can be performed with a filiform as a guide.

If it is impossible to pass an instrument through the stricture, then external urethrotomy must be done without a guide. The injection of methylene blue into the urethra, by staining it a dark blue, enables the operator to identify it more readily, and also to gain entrance to the bladder more easily. This procedure is carried out as follows: After the patient is anesthetized, a 5 per cent. watery solution of methylene blue is slowly injected into the urethra with a small glass syringe. This is retained by compressing the meatus. Another syringe-full is then injected. The methylene blue should be retained for fully 5 minutes. As strictures that are impassable even to a filiform are not necessarily impermeable, the injection of the dye is often possible through the stricture.

6. If nothing can be passed through the stricture, the perineal urethra should be carefully palpated and a vertical cut made in the midperineal line in an attempt to enter the urethra. If successful, the stricture is divided by cutting upward toward the meatus with a slender dull-pointed knife. The bladder is then entered and explored with the finger as previously described. If unsuccessful either in entering the urethra or bladder, 2 courses are open to the surgeon. The quickest method is to perform suprapubic cystotomy. A guide is then passed through the suprapubic wound into the bladder and through the deep urethra to the posterior surface of the stricture. The urethra is then opened on the groove of the guide. The other alternative, suggested by Young, consists in transforming the median perineal incision into a bilateral one by diverging incisions from its posterior extremity, and performing a free dissection of the perineum as in extra-urethral prostatectomy. Upon reaching the apex of the prostate, the urethra is opened at that point.

The method of Cock, which consists of plunging the knife blindly into the tissues in the general direction where the urethra ought to be, is dangerous and is no longer used.

After-treatment.—Following operation the patient is put to bed. The end of the perineal tube is attached by means of a glass coupling to a piece of rubber tubing, sufficiently long to hang over the side of the bed and drain into a glass flask attached thereto or on the floor. The capacity of the glass vessel should be about 2 quarts and it should contain sufficient 1:40 carbolic solution to immerse the end of the tube. In order to prevent the outflow tube from dragging on the perineal tube a piece of adhesive plaster is wound around it and pinned to the bed. The tube is thus held, allowing enough slack to permit the patient to move and also allow him to turn upon his side. The quantity of urine passed in 24 hours should be noted.

In the evening of the first day the bladder is irrigated with boric acid solution through the perineal tube.

On the first day after operation the bladder is irrigated morning and evening with hot boric acid solution.

(I have done hundreds of external urethrotomies for tight perineal strictures and have never been obliged to resort to retrograde catheterization through a suprapubic incision.—EDITOR.)

In the morning of the second day after operation the urethra and bladder are washed out with boric acid solution. The perineal tube is then withdrawn and sounds are passed beginning with 20 French. If 5 per cent. alypin is first injected into the anterior urethra and through the perineal wound into the deep urethra, very little pain will be caused by instrumentation. After sounds are passed, a metal catheter is passed into the bladder which is then irrigated with 1:4,000 silver nitrate solution. The perineal tube is then replaced. In the evening the bladder and urethra are again irrigated with boric acid.

On the third day the urethra and bladder are irrigated with the silver nitrate solution in the morning and with boric acid in the evening.

On the fourth day the same treatment is carried out as on the second day, except that the perineal tube is discarded. A small piece of gauze is introduced into the perineal wound to insure healing from within outward. If this point is neglected, it frequently happens that the perineum will heal and subsequently break down again.

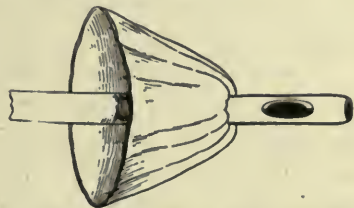


FIG. 22.—CATHETER EN CHEMISE.

Sounds are then passed every other day or every third day until the perineal wound closes. This usually takes 2 or 3 weeks. After each passage of sounds, the bladder is filled with 1:3,000 silver nitrate through a metal catheter, which is then withdrawn, the patient being told to urinate by standing up, with thighs together and a gauze pad pressed against the perineum.

If the sounds are passed with difficulty, or if they cannot be made to enter without using undue force, the anterior urethra should be slowly stretched with an Oberlaender dilator, after which sounds are passed.

To insure a daily movement of the bowels, a saline laxative is administered every morning. A wineglassful of Hunyadi or Carabana water serves equally well.

Temperature Following Operation.—There is usually a postoperative rise in temperature on the evening of the first day and on the following day ranging from 99° to 101° F. In some cases it continues until the tube is removed. In old cases of tight stricture complicated by chronic urethritis or cystitis, the temperature may rise to 105° F.

Urethral fever, after the passage of sounds, can usually be avoided by inserting a rectal suppository containing morphin sulphate, gr. $\frac{1}{4}$, and quinin sulphate, gr. x, just before instrumentation. Urotropin is given in 10-gr. doses 3 times a day. If it is not well tolerated, benzoic acid, gr. x, or salol, gr. v,

is given instead. The patient should drink plenty of water. If the temperature is high, sounds should be passed less frequently.

Complications.—1. **HEMORRHAGE.**—Postoperative hemorrhage rarely occurs unless the plexus of Santorini or other important vessels have been cut, or undue force has been used in passing instruments. In mild cases it is controlled by exerting pressure against the perineum with a pad. In severe cases the bleeding vessels should be looked for and ligated. Hemorrhage may also be controlled by the catheter *en chemise*, which consists of a woven catheter around which a piece of gauze has been tied (Fig. 22). This is introduced in the perineal wound for a sufficient distance to have the chemise well within the perineal opening. The space between the catheter and chemise is packed with cotton or gauze packing 1 inch, and the whole kept pressed in place with a pad and a T-bandage.

If the hemorrhage comes from the anterior urethra, it may be stopped by injecting adrenalin chlorid 1:1,000 or peroxid of hydrogen. If these fail, a large size woven catheter is passed into the urethra and the penis bandaged snugly around it.

2. **SPASM OF THE BLADDER.**—This may be due to clogging of the perineal tube and filling of the bladder with blood-clots, or the perineal tube may slip into the bladder and irritate the vesical wall by pressing against it. In either case the clots should be washed out and the tube withdrawn so that its eye just projects into the vesical cavity. Sometimes the mere presence of the tube is enough to excite spasm, in which case the patient should be kept under the influence of narcotics for the first 24 hours. If spasm persists, a smaller tube should be inserted. The following is a useful formula for controlling vesical irritability:

R	Sodium benzoate	oz. i	30
	Tr. Belladonna	oz. ss.	15
	Aq. menth. pip. ad.....	oz. iv	120
M. Sig.	One teaspoonful three times a day in a glass of water.		

3. **INFECTION.**—Infection is most apt to occur in cases with impassable stricture or tight tortuous strictures in which difficulty has been encountered during operation. It may also occur when stricture is complicated by severe cystitis or urinary extravasation. It may assume any of the forms of urinary fever. It is best combated by the free internal administration of water and urotropin given in from 10- to 15-gr. doses every 4 hours. The bladder should be irrigated every day with silver nitrate solution through the perineal tube. To insure drainage, the tube should not be removed as long as the temperature is high. Sounds should not be passed as long as the temperature is high.

4. **CUTTING INTO THE RECTUM DURING OPERATION.**—This accident occurs but rarely. It has happened when, as the result of some chronic inflammatory condition, dense cicatricial tissue has been deposited between the rectum and urethra

just below the apex of the prostate. A puff of gas may be detected indicating that the rectum has been cut. If this occurs, pass a purse-string suture through the rectal cut and invert it still more by 2 transverse sutures, using No. 2 9-day catgut.

5. PHLEBITIS.—Phlebitis (milk leg) is a rare complication. Guiteras reports a case in which this occurred in a patient who got up out of bed too soon after operation and who suffered from severe hemorrhage after the passage of sounds. The phlebitis was accompanied by considerable edema of one leg, which subsided uneventfully in several weeks under symptomatic treatment.

Results.—The results following these operations are very satisfactory. The mortality, according to the statistics of various operators, is less than 2 per cent. in external urethrotomy and practically nil in internal urethrotomy.

COMBINED INTERNAL AND EXTERNAL URETHROTOMY

The combined operation of internal and external urethrotomy is indicated when strictures are present in both the perineal and pendulous urethra, or if the strictures are all anterior and perineal section is necessary for drainage.

The operation is performed in 2 ways: either internal urethrotomy is done first, followed by the external, or the perineum is first opened and the strictures in the anterior portion operated upon by the internal route.

The method of operating is determined by the character and location of the strictures. If the strictures are all anterior, none being present in the perineum, then the internal operation is performed first, followed by perineal section. If strictures are present both in the bulbous and penile urethra, then perineal section followed by internal urethrotomy is the method of choice, because the perineal strictures are usually the tightest, and, by attending to them first, a freer space is left in which to do the internal urethrotomy. In these cases the external urethrotomy is performed up to the point at which the gorget or grooved director is introduced through the deep urethra into the bladder, after which the urethrotome is introduced into the urethra until its tip lies in the groove of the instrument. If the anterior strictures are of small caliber, they are first cut with the Maisonneuve urethrotome and the operation completed with the Otis instrument.

Having cut the anterior strictures, the perineal tube is inserted and the same after-treatment given as described under external urethrotomy.

FUTURE MANAGEMENT OF PATIENTS OPERATED UPON BY URETHROTOMY

After the patient is up and about, the urethra should be kept open either with sounds or dilators until healing is complete and there is no tendency to contraction. The passage of instruments is always followed by irrigations of silver nitrate solution beginning with 1:4,000, gradually increasing in strength. After the patient is discharged he should return in 6 weeks and sounds passed

to insure the patency of the urethra. In 6 months he should return again for examination. If this course is adhered to, any tendency to contraction is quickly overcome, and the necessity of secondary operations done away with.

(Any tendency toward recontraction after operations for stricture of the urethra are evident in a few weeks. If no difficulty is found in passing a full-sized sound 6 weeks after the operation, the patient is almost certainly cured. If difficulty exists soon after the patient has been operated upon, he is not cured and must either undergo a second operation or resign himself to fate and have sounds passed at intervals during the remainder of his wretched life.—EDITOR.)

EXTERNAL URETHROTOMY UNDER LOCAL ANESTHESIA

The patient is prepared for operation as previously described. The local anesthetic used is either 2 per cent. cocain or 5 per cent. alypin. About 20 minims are instilled into the deep urethra, after which the anterior urethra is distended with the same solution. At least 15 minutes should be allowed to elapse for the anesthetic to take effect. For infiltrating the skin, 2 per cent. alypin, 1:250 cocain, or 2 per cent. novocain may be used. The skin is infiltrated in the median line, beginning about 1 in. in front of the anal margin and extending forward to the scrotum. The incision is then made without waiting. The cut can usually be carried down to the accelerator urinæ muscles without further infiltration. The muscles of the bulb are then infiltrated in the median line and laterally, so that the urethra will be surrounded with a layer of the anesthetic. The urethra is then incised over the guide.

The operation is usually painless up to this point, but on attempting to pass the finger through the cut-off muscle much pain may be caused. This may be obviated by injecting the anesthetizing solution around the membranous urethra by means of a long hypodermic needle passed into the bulbous portion of the urethra. It is better, however, to tell the patient that he will have pain for about a moment and rapidly insert the finger through the membranous urethra. The prostatic urethra and bladder can be palpated without pain, providing that part of the finger surrounded by the neck of the bladder is not moved. The operation is then concluded in the usual way.

The operation under local anesthesia is limited to those cases in which the stricture is of fair size and passable, or when perineal section is performed for drainage. Unless there is some special reason, it should not be attempted in tight, tortuous, or impassable strictures, or in any case where the operator anticipates difficulty in entering the bladder.

RESECTION AND EXCISION OF STRICTURES: URETHRECTOMY

If only a portion of the urethra is excised, the operation is known as partial urethrectomy or urethrorrhaphy; if the urethra is completely excised, it is

termed complete urethrectomy. The former is the operation of choice, because, by leaving a portion of the dorsum of the urethra, firmer union can be obtained than by approximating completely divided segments.

Indications.—This operation is indicated particularly in fibrous, tortuous, or traumatic strictures. The operation can be performed on any part of the canal, but is most frequently employed in the perineal portion.

PARTIAL URETHRECTOMY

Technic.—The patient is prepared for operation as described under external urethrotomy. If possible, a guide is passed through the stricture into the bladder. If the stricture is impassable, the tunneled sound is passed down to

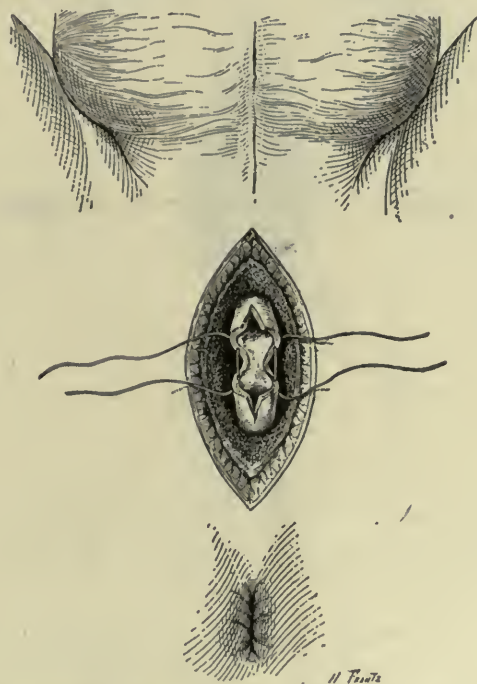


FIG. 23.—PARTIAL URETHRECTOMY, SHOWING POSITION OF THE LATERAL SUTURES. (Albarran.)

the anterior wall of the stricture. The perineal incision is then made and the edges of the wound retracted. If the guide has passed through the stricture, an incision is made through the stricture to the groove of the guide. If the guide has not been passed through, the incision into the urethra is made just anterior to the stricture, over the end of the guide. Dense tissue around the urethra is then dissected away. The urethra, being held open by tenaculum hooks, is split longitudinally along its floor until the stricture has been completely divided. That part of the urethra corresponding to the floor and sides is then incised, and a median longitudinal slit is made in the upper and lower

cut edges of the floor of the urethra. Longitudinal sutures are then passed as follows: One on either side, to unite the gap in the side walls (Fig. 23); these are tied and the cut ends used for traction sutures; one in the median line; and one on either side of this. The sutures, which are of No. 1 chromic gut, pierce the outer wall of the urethra, not touching or going through the mucous membrane (Fig. 24).

A soft rubber catheter is then passed through the urethra into the bladder

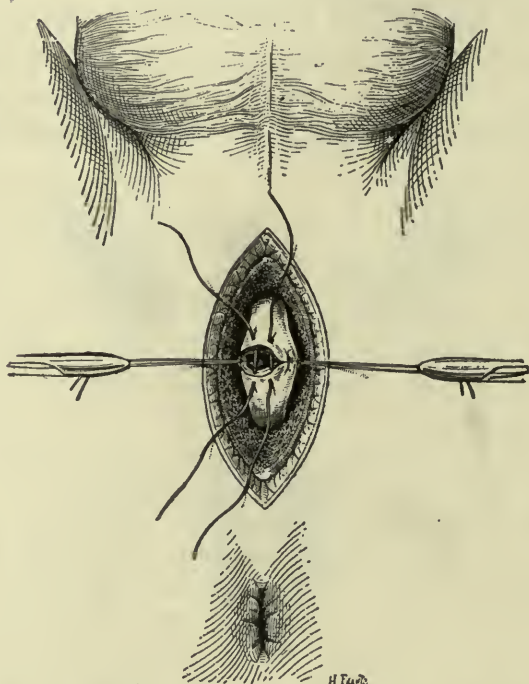


FIG. 24.—PARTIAL URETHRECTOMY. The lateral sutures are tied and used as traction sutures. Position of remaining sutures seen. (Albarran.)

and retained for 1 week, unless it gives rise to irritation, in which case it is withdrawn on the fourth or fifth day. The perineum is closed with interrupted sutures, except just over the sutured portion of the urethra.

After-treatment.—The bladder is washed out, morning and night, with warm boric acid solution. After the removal of the catheter, the urethra is cautiously dilated every second day with the Oberlaender dilator, followed by sounds. If the perineal wound suppurates, the skin and deeper sutures are removed and the wound irrigated and drained as described under perineal section.

COMPLETE URETHRECTOMY

Technic.—A median perineal incision is made down to the stricture. The field of operation is freely exposed and all dense tissue, if present, dissected

from around the urethra. The urethra is then steadied with forceps and a transverse incision made through it above and below the strictured portion. The cut ends of the urethra being held with tenacula, a median longitudinal slit is made in the cut edges on the floor of the upper and lower urethral segments. Two sutures are then passed through the dorsal portions of the cut parts (Fig. 25). These sutures pass entirely through the wall of the urethra and are tied



FIG. 25.—COMPLETE URETHRECTOMY. Showing two sutures uniting the roof of the urethra. (Albarran.)

on the inside. A lateral suture is then passed on either side and tied. These sutures are then used as lateral traction sutures. The remaining 3 sutures are placed the same as in the preceding operation. All the sutures except the first 2, which unite the roof of the urethra, pass only through the submucous and muscular coats of the urethra and not through the mucosa. The after-treatment is the same as in partial urethrectomy.

REPAIR OF ACQUIRED DEFECTS OF THE URETHRA

General Considerations.—Fistulæ of the urethra may be due to injuries from external or internal causes, giving rise to abscess formation or urinary extravasation. If the urethra is injured or cut too deeply during the performance of internal urethrotomy, fistula may result. These sometimes follow external urethrotomy. Peri-urethral abscess is a frequent cause. A calculus caught

at some point of the urethra may ulcerate through, causing fistula. Syphilis, tuberculosis, and cancer are occasionally, though rarely, causative factors.

Fistulæ may occur in any part of the urethra. They are found most frequently either in the penile portion near the frenum, following peri-urethral abscess, or in the perineum, where they often complicate stricture. They may communicate with the rectum, in which case they are called urethrorectal fistulæ.

Before attempting repair, the direction and character of the walls of the fistulous tract should be noted. The general direction of the fistulous canal is

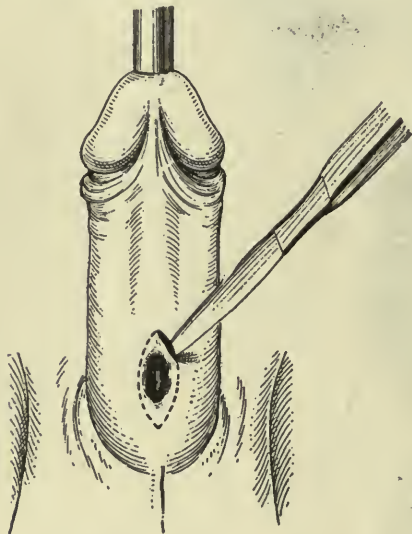


FIG. 26.—URETHRORRHAPHY. The fistula is excised by two elliptical incisions. (Albarran.)

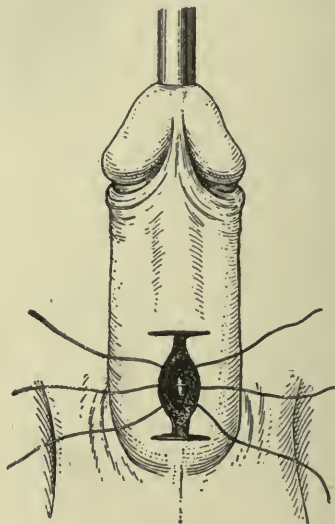


FIG. 27.—URETHRORRHAPHY IN TWO LAYERS, SHOWING INCISIONS AND FIRST LAYER OF SUTURES. (Albarran.)

determined by passing either a fine flexible probe or a filiform through its external opening into the urethra. If a urethroscope is then inserted into the urethra, the position of the internal opening of the fistula can be located. The defect in the urethra sometimes has more than one external opening; these may be demonstrated by injecting methylene blue into the urethra and bladder. When the patient voids, the dye will escape through the fistulous openings. Pressing on the perineum often causes pus and urine to escape from them.

The indications for treatment are to remove the cause and to obliterate the fistulous tract. Thus, if stricture be present, it should first be dilated or cut before attempting repair. If infection be present, appropriate treatment is first instituted to render the field of operation as surgically clean as possible. Operative repair should never be attempted in the presence of active suppuration.

FISTULÆ OF THE PENDULOUS URETHRA

These fistule have a short tract, as the urethral mucosa lies very close to the skin. The operations comprise urethrorrhaphy and urethroplasty.

A. Urethrorrhaphy.—A sound is passed into the bladder and the fistulous opening excised by 2 elliptical incisions made about the fistulous margin with a converging slant toward the urethra. Four transverse sutures are passed through the skin and tissues down to the urethra but not including its mucosa (Fig. 26).

Albarran does this operation in 2 layers. He excises the fistula in the man-

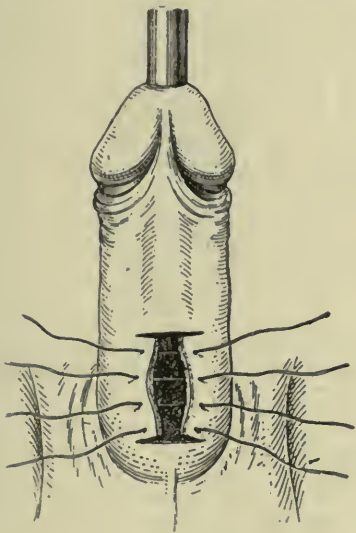


FIG. 28.—URETHRORRHAPHY IN TWO LAYERS, SHOWING SECOND LAYER OF SUTURES. (Albarran.)

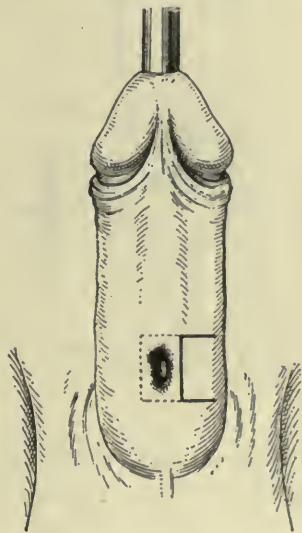


FIG. 29.—URETHROPLASTY WITH ONE FLAP, SHOWING LINES OF INCISION. (Albarran.)

ner just described, after which 2 transverse incisions are made through the skin at the upper and lower borders of the wound. The skin is then loosened from the underlying tissues. Three transverse sutures are passed; these include only the subcutaneous tissues down to but not through the urethra. These are tied. Four transverse sutures are used to unite the skin flaps (Figs. 27, 28).

B. Urethroplasty with One Flap.—This consists in removing a rectangular piece of skin from around the fistula, after which the edges of the fistula are freshened. Two parallel transverse incisions are then made through the skin, extending from the upper and lower borders of the denuded area to one side of the median line. This flap is then dissected from the underlying tissues. Four sutures are then passed, uniting the free border of the flap to the opposite side of the denuded area, thus covering the fistula (Figs. 29, 30).

C. Urethroplasty with Two Flaps.—(SZYMONOWSKI'S OPERATION).—Two transverse incisions are made through the skin, one just above the fistulous open-

ing and the other at a corresponding distance below it. A vertical incision is then made connecting the midpoints of the transverse incisions. The 2 flaps are then dissected free on either side (Fig. 31). A rectangular flap is then made with its base pointing upward, slightly larger than the fistulous opening.

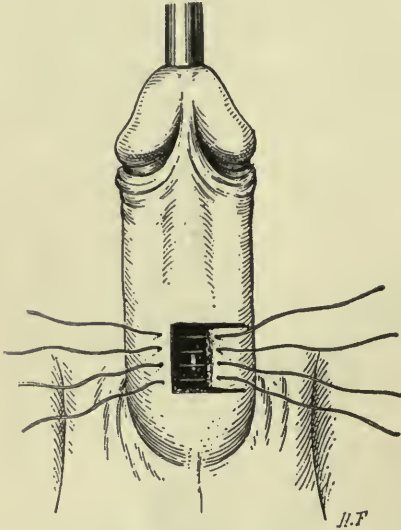


FIG. 30.—URETHROPLASTY WITH ONE FLAP, SHOWING HOW SUTURES ARE PLACED. (Albarran.)

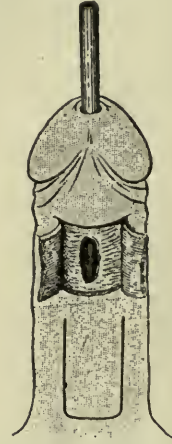


FIG. 31.—URETHROPLASTY WITH TWO FLAPS. The lateral flaps are reflected back and the line of incision of the lower flap marked out.

This is dissected free and turned up so as to cover the fistula. Its free edge is then tucked beneath the upper transverse incision and fastened by 2 sutures (Fig. 32). Sutures are then passed through the edges of the raw surface below, approximating them as much as possible without making undue tension (Fig. 33).

FISTULÆ OF THE PERINEAL URETHRA

Single or multiple fistulæ of the perineal urethra are best treated by perineal section with excision of the fistulous tracts.

Technic.—The patient is placed in the lithotomy position and a grooved metal guide is passed through the urethra into the bladder. A median perineal section is then performed, opening the canal on the guide and cutting any strictures present in this locality. The meatus and any narrowings situated anteriorly are cut to 31 French. The fistulous tracts are then split open from their external to their internal openings. They are thoroughly curetted with a sharp curet and the edges trimmed. If the walls of the fistula are rigid, the entire tract should be excised, using sharp-pointed curved scissors. A perineal tube is inserted through the wound into the bladder. This is retained 4 days, at the end of which time it is removed and a soft rubber coude catheter is passed through the urethra into the bladder and retained for 1 week or more, while the

fibrous tissue about the perineal urethra is undergoing absorption. A small gauze drain is left in the perineal wound until the urethra has healed. Sounds are not passed until the twelfth day after operation, otherwise the after-treatment is the same as in perineal section.

If there is much hard and nodular scar tissue in the perineum, especially if 2 or more fistulæ are present, more radical operation is necessary. The guide is introduced into the bladder, and a straight perineal incision made down upon it. Two elliptical incisions are then made on either side of the central incision, through all the tissues down to the urethra. The incisions are made in a sloping



FIG. 32.—URETHROPLASTY WITH TWO FLAPS. The lower flap is turned up tucked under the upper edge of the wound. It is held in position with two sutures.

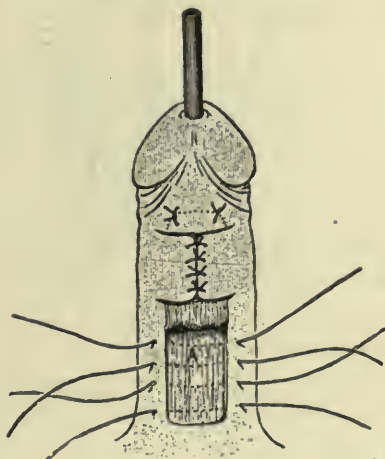


FIG. 33.—URETHROPLASTY WITH TWO FLAPS, SHOWING HOW REMAINING SUTURES ARE PASSED.

direction. All scar tissue is dissected away. A 24 or 25 French coué catheter is passed through the urethra into the bladder. The perineum is then closed by interrupted sutures, which pass through all the tissues down to but not including the urethra. The perineal tissues are sometimes so thick that the edges are brought together with difficulty. If the thighs are first extended and brought together, the sutures are more easily tied and better union secured. The patient's knees should be held together by strips of adhesive plaster. The catheter should not be withdrawn until union of the deeper tissues has taken place, which requires about 2 weeks.

URETHRORECTAL FISTULÆ

Before attempting repair, the urethra should be put in as normal a condition as possible. If strictures are present, they should be dilated or cut. The urethra should be rendered as surgically clean as possible by a course of preliminary treatment consisting of irrigations with silver nitrate and the internal administration of urotropin, gr. x, three times a day.

Technic.—The patient is prepared as described under external urethrotomy. Before being brought to the operating room, the rectum is thoroughly emptied and cleansed with enemata. After being anesthetized, the patient is placed in the lithotomy position. A grooved director is passed through the rectal opening of the fistula into the urethra. A transverse incision $2\frac{1}{2}$ in. long is made through the skin about 1 in. in front of the anal margin. A vertical incision is then made, extending upward from the middle of the first incision to the scrotum. By careful dissection the urethra is separated from the rectum.

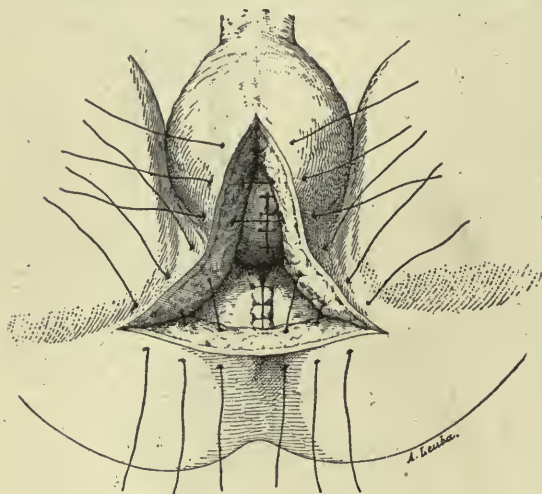


FIG. 34.—SHOWING RECTAL AND URETHRAL SUTURES TIED AND SKIN SUTURES PASSED. (Albarran.)

If possible the fistulous tract is dissected free and ligated above near the urethra and below close to the rectum. The rectal stump of the fistula is buried by 2 sutures, which do not include the mucous membrane. If the urethra and rectum about the fistula are so densely adherent that it is impossible to separate them without cutting into them, the fistulous opening in both is excised. The rectal opening is closed by 2 layers of sutures which do not include the mucous membrane. The urethral opening is closed by interrupted transverse sutures which go through the urethral wall, excepting the mucosa. The skin wound is closed by interrupted sutures (Fig. 34). A retained catheter is passed through the urethra into the bladder and kept there until union takes place. The bowels are not moved for 4 days.

ELECTRICAL TREATMENT OF FISTULÆ

Fistulæ situated near the frenum resulting from peri-urethral abscess can often be closed by electrical treatment. Fistulæ of the perineal urethra do not respond to this form of treatment, and it is usually a waste of time to attempt to close them with electricity.

Technic.—If the meatus is small, a preliminary meatotomy is performed. Insert a dull-pointed needle electrode, connected with the negative pole, into the fistulous opening. The positive electrode is placed on the patient's abdomen. The application of the current, which is 5 milliampères, should not exceed 10 seconds. A soft rubber catheter is inserted into the urethra and retained there for 3 days in order to divert the urinary stream and prevent it from dilating the fistulous opening. Injections of silver nitrate 10 per cent. in the fistulous tract sometimes close them.

RUPTURE OF THE URETHRA

Rupture of the urethra may be complete or incomplete. In incomplete rupture an instrument can usually be passed into the bladder. In complete rupture the guide can usually be passed only as far as the seat of the injury.

Treatment of Incomplete Rupture.—A guide having been introduced through the urethra into the bladder, a free incision is made into the perineum and urethra over the guide. All blood-clots are washed away. A drainage tube is then inserted and the operation completed as in external urethrotomy. The after-treatment is also the same.

Treatment of Complete Rupture.—If the case is seen immediately after injury, a guide is introduced as far as possible into the urethra and the perineum opened upon it. The severed ends of the urethra are then looked for. Usually no difficulty attends the recognition of the penile or distal end, as the instrument is seen passing through it. The recovery of the proximal end is often very tedious and difficult. If it is secured successfully, repair is effected as described under excision of strictures. If the proximal end cannot be found, a suprapubic opening is made and the severed end of the urethra revealed by retrograde catheterization, after which end-to-end anastomosis is done. If the case is seen at a later date, the swelling and edema are usually so marked that repair should not be attempted. If the perineal wound is sufficiently large and drainage is free, the patient is allowed to urinate through the perineal wound until the swelling and extravasation have subsided. If drainage is not free, perineal section is performed and a perineal tube inserted. No attempt is made at repair until the tissues return to the normal, when end-to-end anastomosis may be attempted.

URETHROSCOPIC DIAGNOSIS AND TREATMENT

CHAPTER IV

URETHROSCOPIC DIAGNOSIS AND TREATMENT

DAVID GEIRINGER

Since Oberlaender in 1893 wrote his text-book on urethroscopy, remarkable progress has been made in the diagnosis and treatment of urethral disease. With the aid of the urethroscope, Kollmann and Oberlaender so perfected the diagnosis and treatment of chronic urethritis, that although considerable changes have since been made in therapy, their fundamental ideas and teachings are accepted by all urologists. In their studies they employed the straight endoscopic tube.

When this method of diagnosis and treatment was taken up by urologists in general, they found that, although a fairly good view of the anterior urethra was obtained with the straight tube, a great deal of practice and experience were necessary to correctly interpret any pathological changes, because the images were so small that but little could be seen. Examination of the posterior urethra very often proved difficult and painful, and frequently impossible because of the technical difficulties in trying to introduce a straight tube into a sensitive posterior urethra. Even when the tube was introduced successfully, hemorrhage and urine obscured the field, necessitating constant swabbing in order to obtain a clear view.

Because of these difficulties, the deep urethra received but little attention until 1907, when Goldschmidt introduced his irrigation urethroscope, which gave a splendid view of the posterior urethra and the vesical sphincter. As a result of this improvement in posterior urethroscopy, many of the sexual and urinary disturbances which were formerly called sexual neurasthenia and were but little understood are now known to be caused by lesions of the posterior urethra and verumontanum.

URETHROSCOPES

The urethrosopes which are in use at the present time may be divided into 2 general classes. The first variety, called endoscopic tubes, consists of straight

eylindrical metallic tubes through which the urethra is viewed. The illumination is obtained by means of a small electric light fastened to the ocular end of the tube or introduced into the tube by means of a slender metal carrier.

Urethroscopes of the second variety, called irrigation urethroscopes, are constructed upon the same principles as the cystoscope. They consist of a sheath into which a telescope is inserted, through which the urethra is examined while it is being distended with water.

As the method of using these 2 types of urethroscopes differs materially, I will first describe the various forms of endoscopic tubes and how to use them, after which the irrigation urethroscopes will be considered.

ENDOSCOPIC TUBES

Although there are many different models of endoscopic tubes, they are all constructed on the same principle and differ but very little from one another. Only those which are most serviceable for diagnosis and treatment will be described.

The simplest type of endoscopic tube consists of a straight metal tube, 6 in.



FIG. 1.—STRAIGHT ENDOSCOPIC TUBE AND OBTURATOR.

long, ranging in caliber from 23 to 31 Charrière. Each tube is fitted with a blunt-pointed obturator (Fig. 1). The interior of the tube is illuminated by a small cold incandescent lamp fixed at the distal end of a thin rod, which is inserted into the tube (Fig. 2), or the light may be projected from without, as in

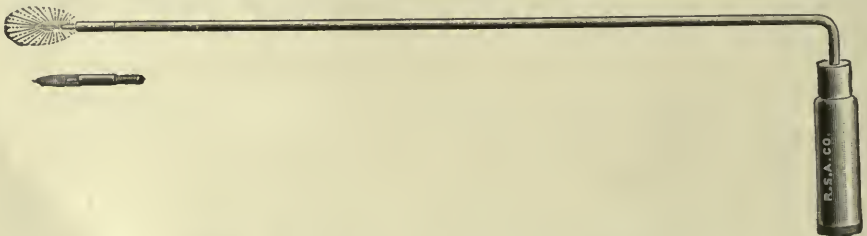


FIG. 2.—LIGHT CARRIER AND LAMP FOR ILLUMINATING THE ENDSCOPE.

the Squier or Hayden modification of the Otis instrument (Figs. 3, 4). The electric current for illumination is obtained either from a storage battery or from the street current. In both instances a controller is necessary to reduce the current according to the capacity of the lamp.

The endoscope just described gives a fairly good view of the anterior

urethra, when a tube of 28 French or more can be introduced, but it is, as a rule, difficult and very often impossible to introduce tubes of this size into the deep

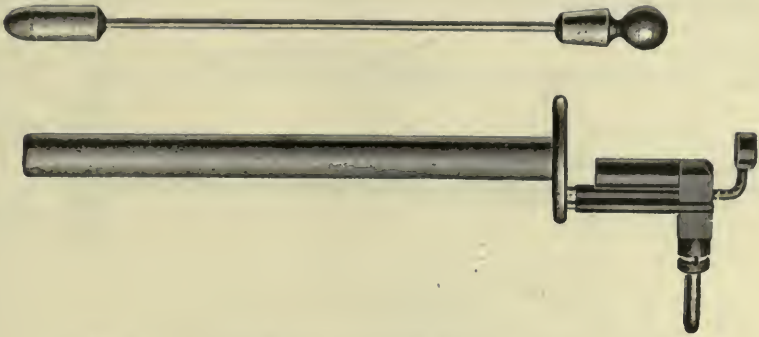


FIG. 3.—SQUIER'S MODIFICATION OF THE OTIS URETHROSCOPE.

urethra. Guiteras' urethroscope (Fig. 5) partly lessens this difficulty. The lower segment of the tube is rounded, thus facilitating its passage over the rigid



FIG. 4.—HAYDEN'S URETHROSCOPIC TUBES FOR THE ANTERIOR AND POSTERIOR URETHRA.

margin formed by the anterior layer of the triangular ligament. The floor of the tube is slightly constricted, forming a shallow gutter through which the light

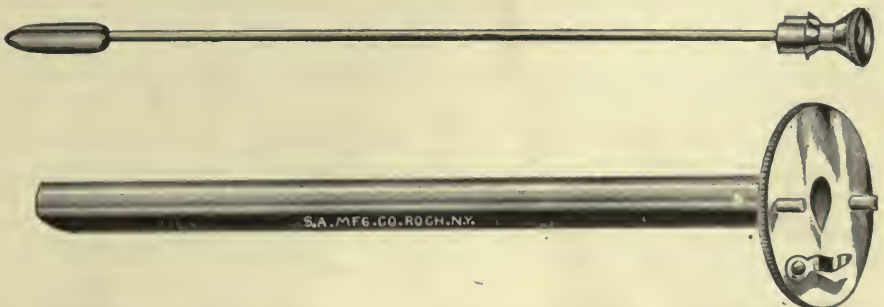


FIG. 5.—GUITERAS URETHROSCOPE. This instrument is designed for use in the anterior and posterior urethra.

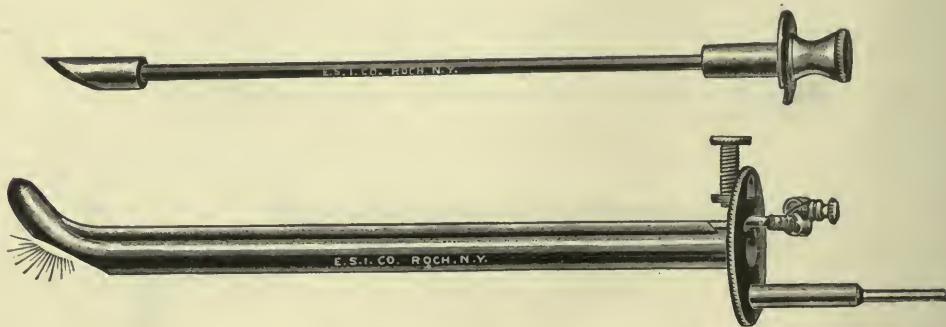


FIG. 6.—SWINBURNE'S POSTERIOR URETHROSCOPE.

carrier is introduced. As a result of this rounding of the distal end of the tube, its lumen is narrowed and a correspondingly smaller urethrosopic image is seen. It is, however, easier to introduce and, therefore, more useful than the cylindrical endoscopic tubes just described.

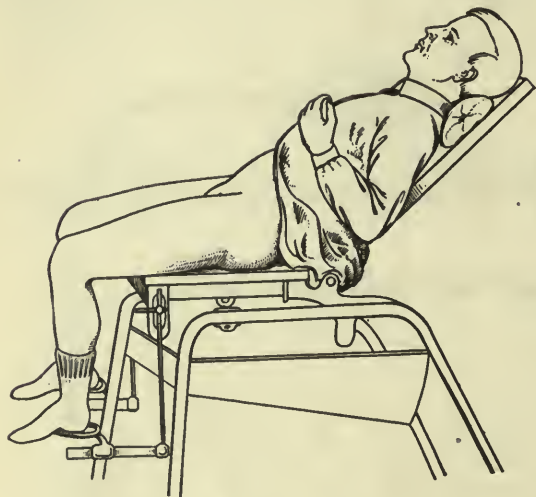


FIG. 7.—POSITION OF PATIENT FOR ENDOSCOPY.

Swinburne has devised a posterior urethroscope consisting of a straight tube with a curved beak which is fenestrated on the convexity (Fig. 6). It is illuminated by a lamp inserted into the tube on a light carrier and is easily introduced, but only the floor of the deep urethra can be seen through it. It often causes bleeding which obscures the image and necessitates constant swabbing to obtain a good view. It is a con-

venient instrument for making applications to the verumontanum.

Hayden's posterior urethroscope (Fig. 4) is similar to the Swinburne instrument, except that the illumination is derived from a lamp fixed in the floor of the tube near its ocular extremity. It is in addition provided with an air dilating attachment for distending the urethra while it is being examined.

Instruments and Apparatus Required for Endoscopy.—The following equipment is necessary for endoscopy:

Set of endoscopic tubes and obturators, sizes 23 to 31 French.

Urethrosopic lamps.

Rheostat.

Portable storage battery or street current.

Metal applicators, 9 in. long, with spiral ends.

Utzmann instillation syringe.

Blunt-tipped urethral syringe.

Absorbent cotton.

Wide-necked jar containing glycerin.

Sol. cocain 2 per cent., beta-eucain 2 per cent., novocain 4 per cent., or alypin 5 per cent.

Examining table provided with steel stirrups.

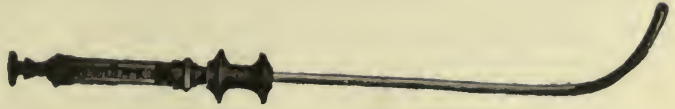


FIG. 8.—ULTZMANN'S INSTILLATION SYRINGE.

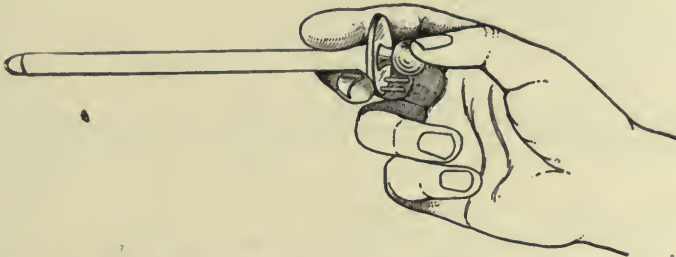


FIG. 9.—SHOWING HOW ENDOSCOPIC TUBE AND OBTURATOR ARE HELD FOR INTRODUCTION INTO THE URETHRA.

Position and Preparation of the Patient.—The patient, having emptied his bladder, lies in the dorsal position, the back of the table being elevated to about 45° . His feet rest on inverted stirrups below its level (Fig. 7).

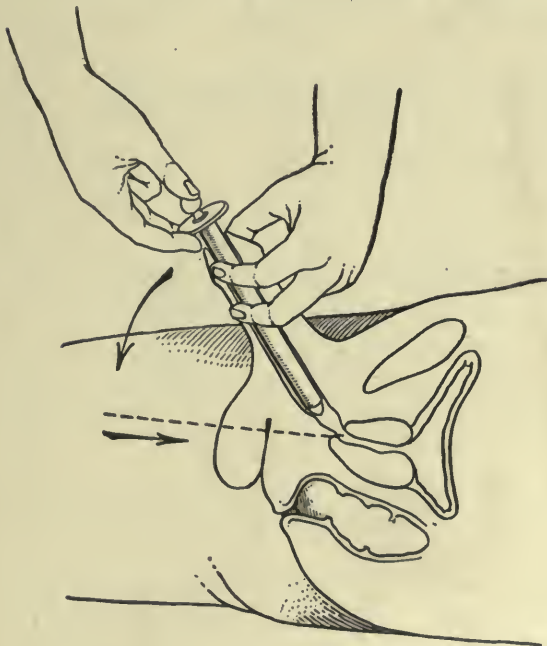


FIG. 10.—INTRODUCTION OF TUBE AND OBTURATOR THROUGH THE ANTERIOR URETHRA DOWN TO THE CUT-OFF MUSCLE.

The urethroscopic lamps are then tested and placed on a small table with the other instruments and solutions within convenient reach of the surgeon. A number of swabs are next prepared by winding cotton around the ends of the applicators.

The urethra is anesthetized by instilling about 10 drops of either 2 per cent. cocain, 2 per cent. beta-eucain, novocain 4 per cent., or alypin 5 per cent. into the posterior urethra, with an Utzmann syringe (Fig. 8), and distending the anterior urethra with the same solution.

Technic of Examination.—The surgeon stands between the patient's thighs, with his left side turned toward the patient. In front of him, on the patient's left, is a small table upon which the sterilized instruments and solutions required have been placed. He selects the largest sized tube which the meatus

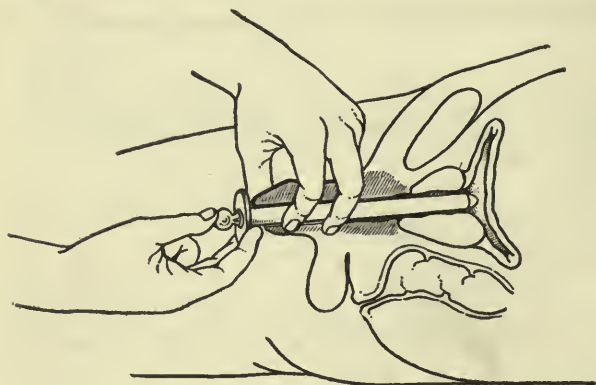


FIG. 11.—SHOWING PASSAGE OF STRAIGHT TUBE AND OBTURATOR THROUGH THE POSTERIOR URETHRA.

will easily admit and holds it in such a way that his thumb rests on the obturator and his fore and middle fingers are on either side of the tube (Fig. 9). By holding the tube in this way, it can be easily controlled and the obturator can be prevented from slipping outward while it is being inserted. He steadies the penis with the left hand, dips the tube into glycerin, and gently inserts it in a downward direction into the urethra as far as the cut-off muscle (Fig. 10). He will know when he reaches this part of the urethra by the obstruction offered to the further passage of the instrument. To enter the posterior urethra, the ocular end is depressed, while the distal end is held gently but firmly against the cut-off muscle. Its passage through this part of the urethra can be facilitated by making firm downward pressure on the pubes, causing relaxation of the suspensory ligament of the penis (Fig. 11).

The examiner then seats himself facing the patient. He steadies the tube with the left hand and withdraws the obturator with the right. Swabs are now introduced and any glycerin, blood, or urine obscuring the field is removed (Fig. 12). The light carrier is then inserted and fastened to the pins or clips on the disk. If reflected light is employed, the lamp is attached directly to the disk (Fig. 3). The current is turned on, and the examiner applies his eye to the ocular end of the instrument

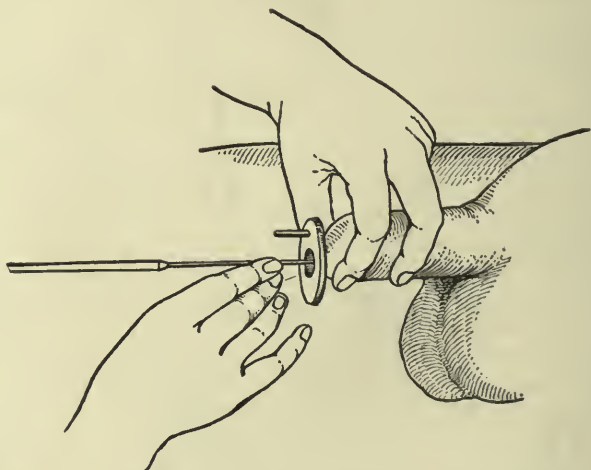


FIG. 12.—SWABBING OUT THE URETHRA TO CLEAR THE FIELD OF URINE OR BLOOD.

and proceeds to inspect the urethra by slowly drawing the tube forward and slightly downward, until the membranous urethra is passed, and then upward and forward to the meatus. In this way a successive series of images of the urethra is seen in much the same way that one sees a railway tunnel when riding on the observation platform of a train.

IRRIGATION URETHROSCOPES

These instruments are constructed upon the same plan as cystoscopes. They consist of an outer metal tube or sheath with a beaked extremity. The illumination is derived from a small cold incandescent lamp fixed in the beak of the sheath or introduced on a light carrier. Near the ocular end of the sheath is a

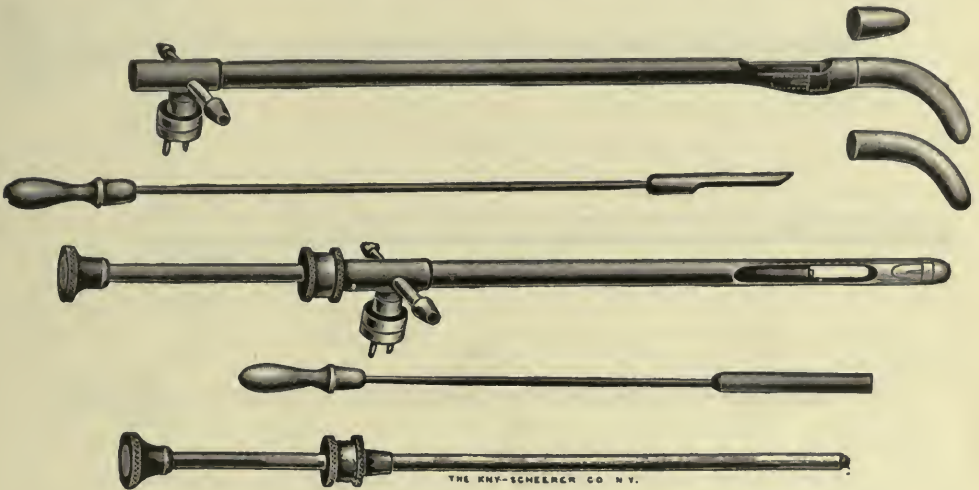


FIG. 13.—GOLDSCHMIDT'S IRRIGATING URETHROSCOPE.

small faucet which, on being connected with an irrigating jar, allows water to flow through the sheath into the urethra, in order to distend it, while it is being examined through a telescope introduced into the sheath.

Goldschmidt's Urethroscope.—Goldschmidt devised the first irrigating urethroscope (Fig. 13). It consists of 1 long and 1 short sheath. The long sheath is provided with 2 detachable curved beaks and is intended for posterior urethroscopy. The shorter sheath has a straight tip and is used for the anterior urethra. The lamp is placed in the distal end of the sheath near the tip. The telescope is provided with a direct lens system giving upright images.

TECHNIC OF USE.—The patient, having emptied his bladder, is placed in the endoscopic position. Anesthetize the urethra if sensitive. Test the lamp. Wipe the lens of the telescope with 95 per cent. alcohol to insure a clear view. Introduce the obturator into the sheath and, after lubricating the latter with glycerin, pass it through the urethra into the bladder, using the same technic as in passing a cystoscope. Steady the sheath with the left hand and withdraw

the obturator with the right. Introduce the telescope into the sheath. Connect the faucet on the sheath by means of rubber tubing to an irrigating jar filled with warm sterile water or boracic acid solution, placed about 3 feet above the table. The surgeon, seating himself facing the patient, turns on the current and applies his eye to the telescope.

The first image seen is the vesical fundus. By slowly drawing the instrument forward, the interureteral band appears. Both ureteral orifices are brought into view by moving the sheath to the right and left. Any pathological condition should be noted (inflammation, ulcerations, tumor stone, foreign body, prostatic enlargement, etc.).

The neck of the bladder next appears, its entire circumference being studied

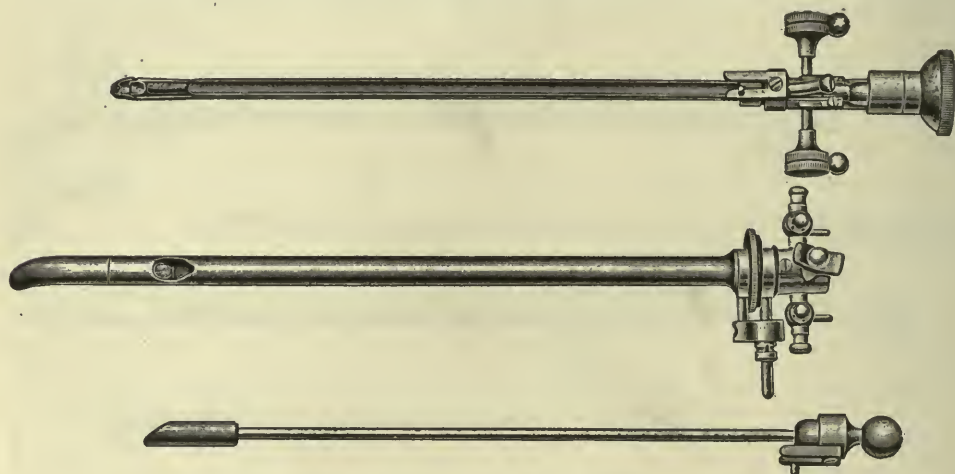


FIG. 14.—BUERGER'S IRRIGATING CYSTO-URETHROSCOPE.

by rotating the instrument. The instrument is now turned so that the fenestra of the sheath looks downward. By slowly drawing the urethroscope forward, the posterior part of the verumontanum comes into view, after which its summit is seen and, just in front of its highest part, the sinus pocularis (utriculus prostaticus) and ejaculatory ducts appear. The prostatic sinuses and lateral walls are examined by rotating the shaft to the right and left. The sheath is now turned so that the fenestra points upward, in order to examine the roof and upper parts of the side walls of the deep urethra. The membranous urethra is next seen. Its ridged appearance is due to the circular fibers of the compressor urethræ muscle, which surrounds that portion of the urethra.

To examine the anterior urethra, withdraw the instrument and use, instead, the shorter sheath with the straight tip. The sheath having been passed down to the cut-off muscle, the obturator is withdrawn and the telescope inserted. The roof, floor, and sides of the bulbous and penile urethra are examined by rotating the instrument and slowly drawing it forward to the meatus.

The Buerger Cysto-urethroscope.—This urethroscope is similar to the Goldschmidt instrument. It consists of a metal sheath with a detachable curved beak

for the deep urethra, and a straight tip for the anterior portion. Its ocular end is provided with 2 faucets for irrigation, and an electric coupling for the lamp. A prism is employed in the optical system, by means of which upright and right-angled images are obtained. The telescope has attached to it an Albarran deflector, the movements of which are controlled by 2 screws at its ocular end. There is also a catheter outlet through which 1 ureter can be catheterized and instruments passed for fulguration electrolysis, incision of cysts, and filiform probing. An obturator completes the instrument.

TECHNIC OF USE.—Buerger advises the following technic: The examiner should familiarize himself with the various parts of the instrument before attempting to use it.

A. Use ordinary cystoscopic preparation and in sensitive individuals anesthetize the urethra. Employ (1) a connecting tube for irrigation through 1 faucet and (2) an irrigator filled with boracic acid solution, situated 3 to 4 ft. above the level of the patient.

B. Test the lamp, watching the illuminated glass window. A great deal of light is not necessary, inspection being at close range. Short-circuiting is prevented by keeping the screw-joint of the beak smeared with wax.

C. Introduce the instrument with the obturator into the bladder; remove the obturator.

D. Wash the bladder if necessary.

E. Insert the telescope, adjusting the irrigating tube to 1 faucet, both faucets being closed. Start flow by opening faucet.

F. If the telescope becomes soiled by secretion, remove and clean it without disturbing the position of the sheath. The distended bladder may be emptied at any time through the other faucet, after pushing the instrument forward so that the fenestra lies in the bladder.

The examination is begun by inspecting the vesical fundus. The trigone is studied by raising the ocular end, thus bringing the fenestra close to the mucous membrane. The ureters are brought into the field by rotating the sheath to the right and left. The examination of the sphincteric margin comes next; its entire circumference can be brought into view by rotating the shaft. The floor of the prostatic urethra is next looked at, after which the instrument is pushed back into the bladder, the fenestra turned upward and slowly withdrawn for viewing the roof and side walls. This last maneuver is often quite painful, and the view is not always satisfactory on account of bleeding and spasm. The membranous urethra is next examined by slowly withdrawing and rotating the sheath. Having examined the prostatic and membranous urethra, the instrument is withdrawn, and the curved beak replaced by the straight tip. The sheath is then inserted with the obturator down to the cut-off muscle. The obturator is then withdrawn and the telescope introduced. The anterior urethra is examined by withdrawing and rotating the instrument until the meatus is reached.

Certain changes in color may be produced by pressure of the instrument upon the mucous membrane. This becomes blanched and the capillaries and vascular streaks turn pale. A little experience, however, will enable one to tell at once if the pallor is a true one, for by holding the instrument steady for a moment, the vascular flow returns and the original color re-appears.

Direct-view Irrigating Urethroscope.—Bearing in mind the limitations of the various urethroscopes in use, I have endeavored to design an instrument of

easy manipulation and simple construction which would give a more comprehensive view of the urethra and at the same time be of equal service in treating it.

The instrument consists of 4 parts: (1) a straight silver endoscopic tube, 9 in. long, 25 French scale caliber; (2) an obturator of the Luys type, provided with a movable beak; (3) a direct-view telescope with a lamp and irrigating attachment for distending the urethra with water; (4) an accessory illuminating

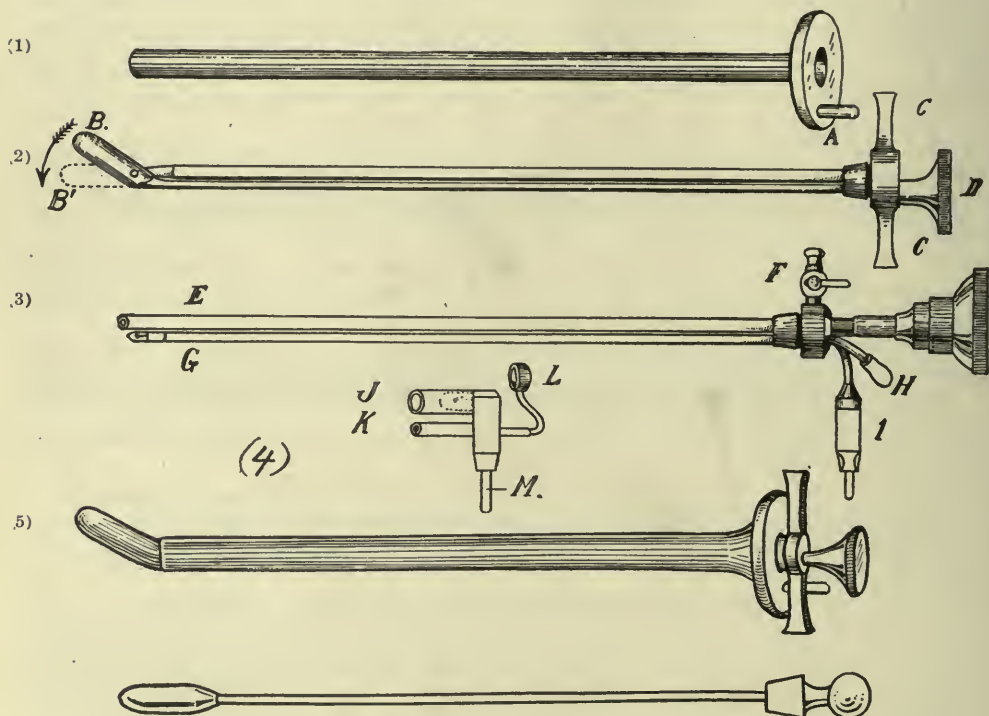


FIG. 15.—GEIRINGER'S DIRECT-VIEW IRRIGATING URETHROSCOPE. 1—Straight endoscopic tube: A—pinion to which the illuminating device (see 4) is attached. 2—Obturator with movable beak: B—movable beak; C—C—handle of obturator. When disk D is pressed upon the beak assumes the position B; when D is pulled out, the beak assumes the position B'. 3—Telescope and light carrier: E—telescope; F—irrigating faucet; G—light carrier and lamp; H—catheter outlet capped with rubber tip; I—electric coupling. 4—Accessory illuminating device: J—electric light and condenser; K—small socket which fits over pinion Figure 1, A; L—small lens which intensifies the urethral image; M—electric coupling.

device to be attached to the disk on the tube. This lamp is capable of projecting a powerful ray of light through the tube into the urethra and is used when local applications are made to the urethra. There is also an accessory tube, 6 in. long, 28 French in size. It is provided with a straight and a beaked obturator and because of its larger caliber is more suitable for treatment. It can also be used with the telescope and irrigating attachment.

Before examining a patient, the surgeon should familiarize himself with the mechanism of the various parts of the instrument. Holding the tube in the

left hand, the obturator is passed into it with the right. The instrument is held in the right hand so that the tube lies between the fore and middle fingers, with the thumb resting on the disk of the obturator (Fig. 16). Pressure with the thumb on the obturator causes its beak to assume a position of about 45° to

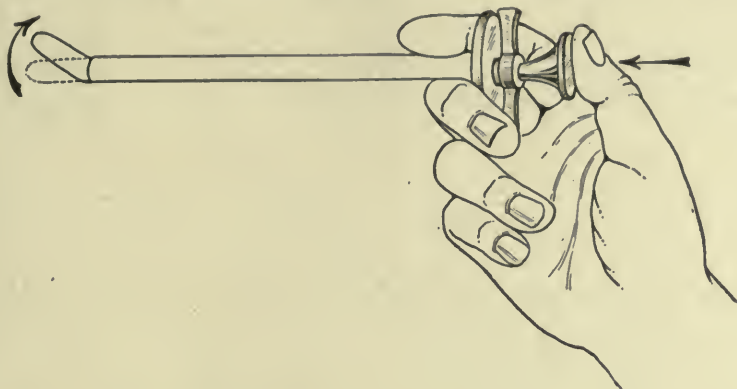


FIG. 16.—METHOD OF HOLDING URETHROSCOPIC TUBE AND BEAKED OBTURATOR FOR INTRODUCTION INTO THE URETHRA.

the long axis of the tube. The obturator is removed, by first pulling outward on its disk (Fig. 17), which brings the beak in alignment with the tube, allowing its withdrawal. Having removed the obturator, insert the telescope with its lamp. Connect the lamp with the rheostat and determine the amount of current

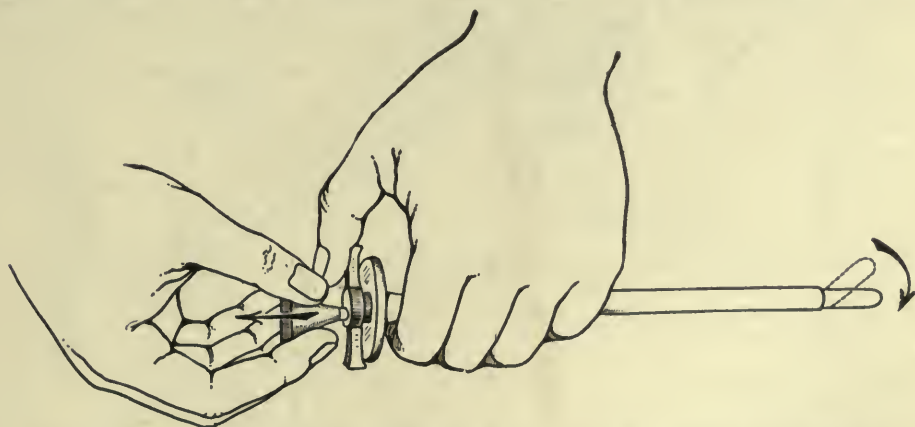


FIG. 17.—METHOD OF WITHDRAWING BEAKED OBTURATOR FROM URETHROSCOPIC SHEATH.

needed for illumination. The telescope is then withdrawn and the accessory lamp attached to the pin on the disk of the tube (Fig. 18) and its current capacity tested.

TECHNIC OF EXAMINATION.—The patient is placed in the endoscopic position with the pelvis near the edge of the table. The urethra is anesthetized if sensitive. The examiner stands at the foot of the table, facing the patient.

He steadies the penis with the left hand and with the right picks up the sheath, into which the obturator has been previously introduced. After dipping this into glycerin, pass it into the bladder, using the same movements as described under passage of the straight tube. During its passage through the urethra

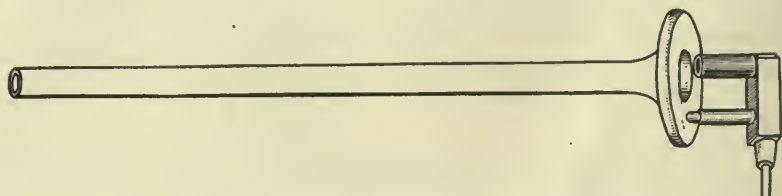


FIG. 18.—AUTHOR'S URETHROSCOPIC TUBE WITH ACCESSORY LAMP.

do not make too much pressure on the disk, but allow the movable beak to accommodate itself to the different curves of the urethra, thereby making its passage easy and painless (Fig. 19).

Having entered the bladder, the sheath is steadied with the left hand. With

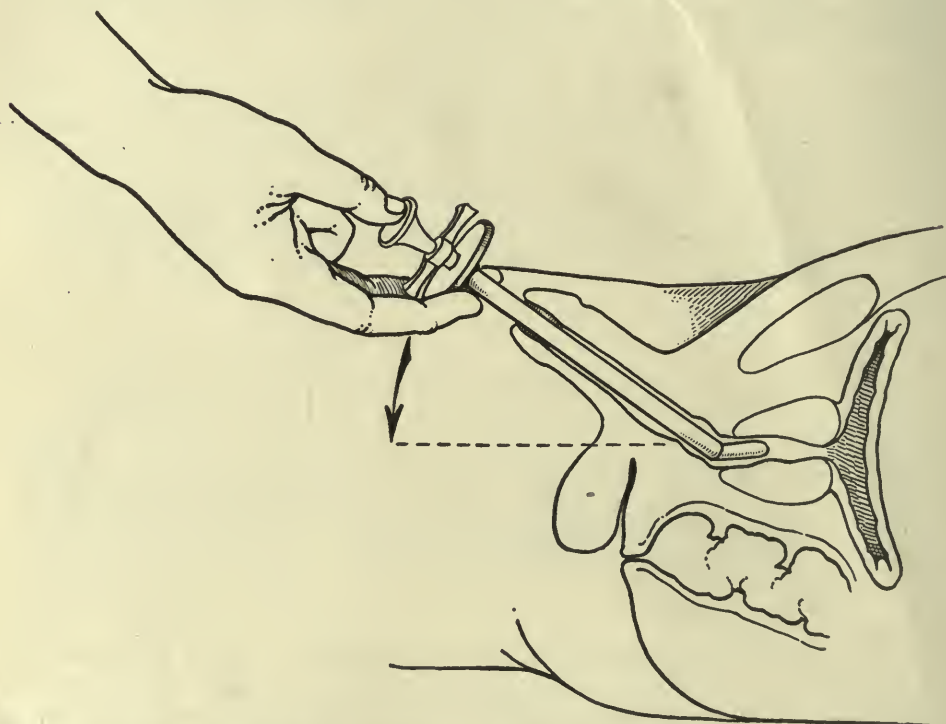


FIG. 19.—INTRODUCTION OF BEAKED OBTURATOR AND TUBE THROUGH THE URETHRA INTO THE BLADDER

the right, the disk of the obturator is pulled outward, straightening its beak. Slightly rotate the handles of the obturator to the right and withdraw it from the sheath. The telescope and light carrier are then introduced. Con-

nect the faucet with the irrigator, which is placed about 3 ft. above the level of the patient, and is filled with warm boracic solution or water. If necessary, wash the bladder until clear. The current is then turned on and the examiner, seated on a stool, applies his eye to the telescope (Fig. 20). By pulling the instrument forward, a series of images of the bladder and urethra is seen. The entire circumference of the internal sphincter and urethra can be seen in 1 image without rotating the shaft. This gives a more comprehensive view than that seen through a telescope provided with a prism, through which only a

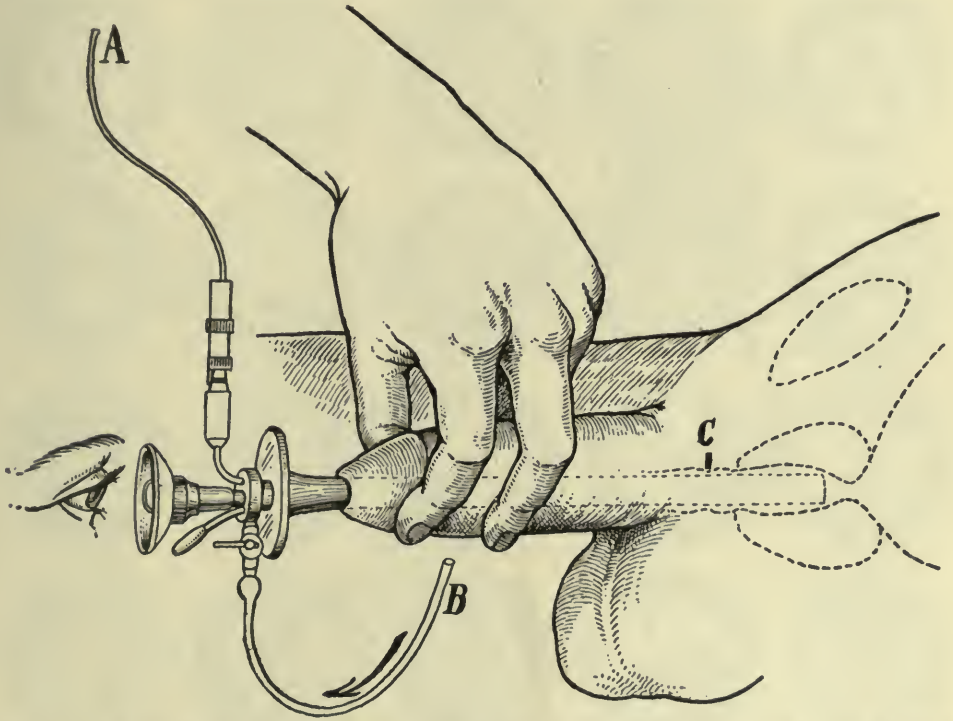


FIG. 20.—POSTERIOR URETHROSCOPY WITH DIRECT VIEW IRRIGATING URETHROSCOPE. As the instrument is withdrawn the ocular end is depressed in order to see the roof of the urethra. A—Electric cable for lamp; B—rubber tube connected with irrigator; C—beginning of membranous urethra.

small area of either the roof, floor, or side walls can be seen at 1 time, thus making constant rotation of the shaft necessary in order to inspect the entire canal. Sometimes, on account of too much distention, the entire circumference of the urethra or internal sphincter is not seen. This is remedied by stopping the flow and drawing the telescope out of the sheath for about an inch. This allows some of the fluid to escape, causing the urethra to partially collapse, which brings all parts into the image. The telescope is then replaced and the examination continued. When desired, the flow is again started.

In examining the posterior urethra it is important to bear in mind that its long axis is about 45° to the horizontal when the patient is in the endo-

scopic position. In order, therefore, to obtain a good view of the structures of that part of the urethra, it is important to depress the ocular end of the instrument sufficiently while it is being withdrawn so that the long axis of the urethroscope will correspond to that of the urethra. Figure 20 shows the correct angle at which the instrument should be withdrawn when examining the deep urethra.

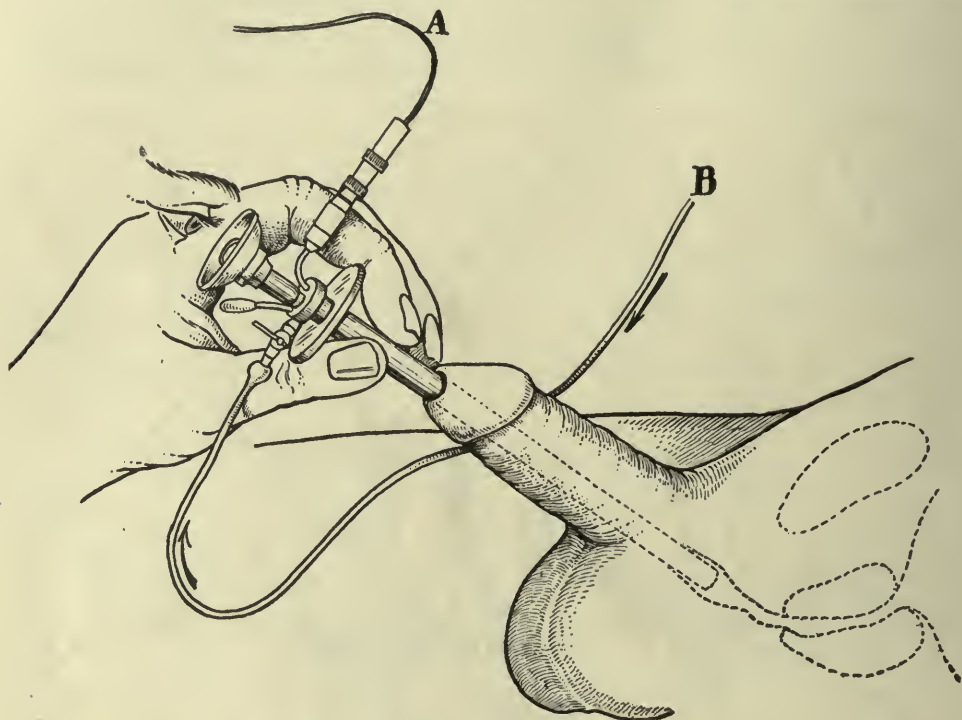


FIG. 21.—ANTERIOR URETHROSCOPY.

Having passed the cut-off muscle, the ocular end of the instrument is elevated and withdrawn at about 45° to the horizontal (Fig. 21).

The surgeon will find this urethroscopic outfit a very complete one for diagnosis and treatment. The beaked obturator allows the easy and painless introduction of a straight tube into the deep urethra and bladder. By means of the direct telescope the entire circumference of the urethra may be seen in 1 image, thereby eliminating the pain and traumatism often caused when an instrument having an indirect telescope or a fenestrated beaked sheath is rotated in order to view the roof and upper portions of the lateral walls of the urethra.

APPEARANCE OF THE URETHRA, TRIGONE AND BLADDER

As I prefer the irrigating urethroscopes for examination, I will briefly describe the appearance of the normal and pathological urethra and also that part of the bladder which can be seen through them.

The instrument being well pushed into the bladder, the "bas-fond" is first seen. Normally it has a pale yellow, slightly pinkish color, and is smooth or thrown into folds, depending on the amount of fluid in the bladder. The blood-vessels are seen forming a loose meshwork (Fig. 22, 1). If the ocular end of the urethroscope is depressed, the overhanging roof of the empty bladder can be examined (Fig. 22, 2). As the instrument is drawn forward slowly, the inter-ureteral band appears as a rounded elevated ridge (Fig. 22, 3). If this is followed to the right or left, the ureteral orifices appear and should be studied as

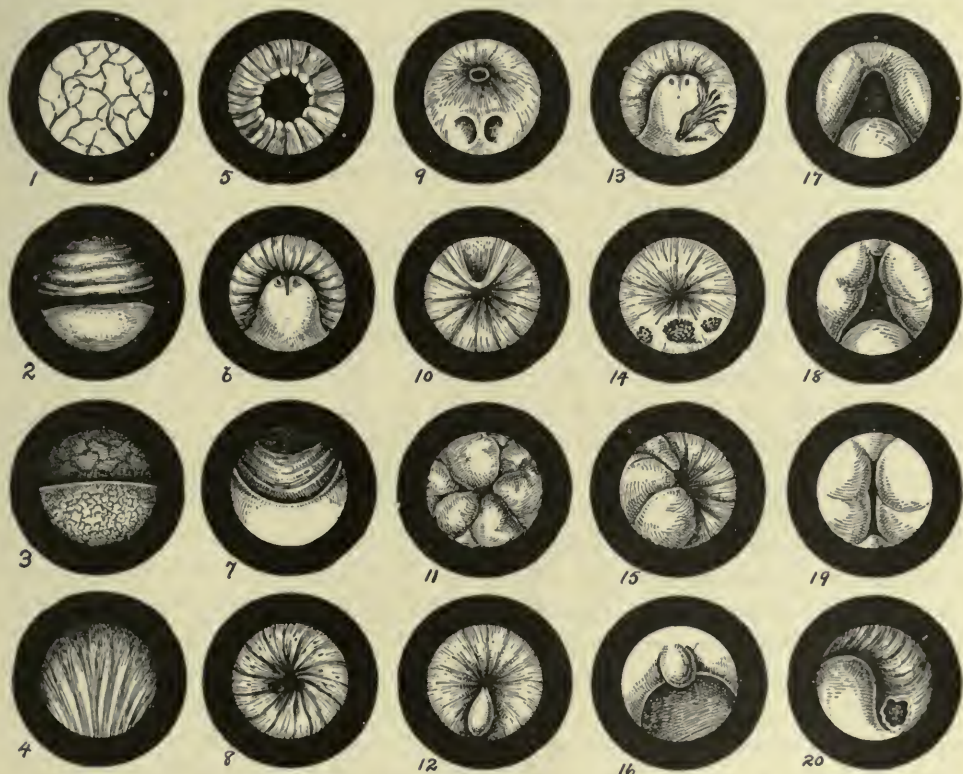


FIG. 22.—URETHROSCOPIC VIEWS OF THE BLADDER, TRIGONE AND THE URETHRA.

described under cystoscopy. By slowly drawing the instrument forward, and moving it from side to side, the trigone is seen. Its color is more pink than the fundus and its blood-vessels are finer in caliber and more closely meshed (Fig. 22, 3). As the vesical neck is being approached the blood-vessels appear larger, lose their meshed appearance, and assume a slightly converging vertical appearance (Fig. 22, 4).

From this point on the movements of the examiner should be extremely gentle and slow, or the patient will strain, interfering with the examination. The entire circumference of the vesical neck next appears (Fig. 22, 5). If only a part of it is seen, stop the inflow of fluid and draw the instrument slightly forward, when the sphincter will present itself. The posterior part of the

colliculus is next seen as an elevated ridge or frenum. There may be 3 or 4 of these frenula. The roof and side walls of the urethra are also in the field.

The next view includes the summit of the colliculus, the side walls and roof of the urethra. The depressions on the sides of the verum (prostatic sinuses, sulci laterales) are plainly seen. The ducts of the prostatic glands, being more numerous in the floor of the lateral sulci, should be looked for in that region. Moving the instrument slightly forward, just anterior to the summit of the verum, one sees the sinus pocularis (utriculus prostaticus) as a small longitudinal cleft, on either side of which the ejaculatory ducts are sometimes visible. On the roof and side walls a few scattered glandular openings may be observed (Fig. 22, 6).

The anterior part of the verum and that part of the prostatic urethra just behind the posterior layer of the triangular ligament next present themselves, after which the posterior layer of the triangular ligament appears as a more or less well-defined ridge on the floor of the urethra. The mucous membrane of the membranous urethra is paler in color than the posterior urethra and is thrown up into thin circular folds, due to the encircling fibers of the compressor urethræ muscle. By depressing and elevating the ocular end of the tube, its roof and walls can be examined. The anterior layer of the triangular ligament next appears as a prominent ridge. Its presence as a urethral landmark is much more constant than the posterior layer (Fig. 22, 7).

Having passed through the membranous urethra, the bulbous urethra is entered. From this point on, the anterior urethra should be examined both in the collapsed and dilated state. By alternately shutting off and turning on the flow, the urethra collapses and expands and we can more readily detect plastic infiltrates of the urethra. When collapsed or but slightly distended, the normal urethra has a funnel-shaped appearance, with from 10 to 16 folds of uniform size radiating from the periphery of the image to the center (Fig. 22, 8).

When the urethra is thickened as a result of hard or soft infiltration, the folds are fewer in number. They are larger and thicker and are not of uniform size. The central lumen, instead of appearing as a circular opening, is distorted, irregularly stellate, or gaping. Its elasticity is also impaired, as shown by its lack of distensibility.

As the instrument is slowly drawn upward and forward, a series of successive images of the entire circumference of the anterior urethra is seen. Its mucosa has a pale yellow pink color and is traversed by longitudinal vascular streaks. The glands of Littré appear as minute pin-point depressions, while the crypts of Morgagni are seen as fine longitudinal slits. The glandular structures should be looked for on the roof of the canal. The openings of Cowper's glands are situated about $\frac{1}{2}$ to $\frac{3}{4}$ in. in front of the triangular ligament on the floor of the bulbous urethra. They are rarely found, however. I recall seeing them clearly only once in the urethra of a clinic patient complaining of a slightly turbid discharge. He denied any venereal disease, but gave a history of excessive masturbation. In his bulbous urethra about $\frac{1}{2}$ in. in front of the cut-off

muscle there were seen 2 crescentic openings placed side by side. They could be probed with a filiform for about $\frac{1}{2}$ in. By inserting the finger into the rectum, and exerting pressure over Cowper's glands, a turbid fluid was seen issuing from them. The urethral discharge contained a few leukocytes, some mucus and epithelium, but no bacteria (Fig. 22, 9).

The penoserotal junction often appears as a rounded elevated ridge on the floor of the urethra. As the meatus is being approached, the lacuna magna is sometimes seen on the roof of the fossa navicularis as a V-shaped opening (Fig. 22, 10).

PATHOLOGICAL LESIONS SEEN THROUGH THE URETHROSCOPE

Having become familiar with the appearance and landmarks of the normal urethra, we will briefly study the various pathological lesions which can be seen through the urethroscope.

1. Chronic urethritis including stricture.
2. Uleer.
3. Polypi.
4. Papillomata.
5. Calculi.
6. Foreign bodies.
7. Solitary cysts.
8. Prostatic hypertrophy.

Chronic Urethritis.—In describing the appearance of the urethra in chronic urethritis, I will use the classification of Oberlaender, who divided it into 2 stages: the first, the stage of *soft infiltration*, consisting of a small round-celled infiltration of the submucosa; the *second stage*, or stage of *hard infiltration*, which includes all the inflammatory changes by which the round-celled infiltration is changed into connective tissue, the final conversion resulting in stricture. This fibroid change likewise affects the urethral glands and crypts. In the early stage of hard infiltration these are inflamed and either remain open or are plugged with secretion; this, Oberlaender calls the glandular form. Later on, as a result of compression by scar tissue around the glands and crypts, their ducts are closed and the glands are obliterated or converted into small oval or round cysts lying beneath the epithelium. This he calls the follicular or "dry form." Small irregular white or yellow patches of sclerotic scar tissue are often seen.

CHRONIC POSTERIOR URETHRITIS.—SOFT INFILTRATION.—Mucous Membrane.—Dark red or bluish red areas, slightly elevated, denote site of infiltrates.

Glands.—A few may occasionally be seen on the roof. Edges of ducts thickened and surrounded by a red areola. No glandular openings visible on floor of prostatic sinuses, on account of redness and swelling of mucous membrane.

Verumontanum.—Dark red, swollen, may fill entire urethra, surface is smooth, granular, eroded, or lumpy, bleeds easily.

HARD INFILTRATION: GLANDULAR FORM.—*Mucous Membrane.*—Pale red, grayish white, or yellow.

Glands.—Mouths of glands gaping or plugged with secretion. Edges are swollen and are red or grayish in color.

Verumontanum.—If involved, may show pale yellow areas; shape is flattened or distorted.

HARD INFILTRATION: DRY OR FOLLICULAR FORM.—*Mucous Membrane.*—Yellowish white with pale, smooth sclerotic areas.

Glands.—Duets rarely seen. May see depressed scars, or occasionally cystic formations (elevated yellowish or grayish-white bodies). In one case of urethritis cystica chronica, the side walls of the urethra were studded with innumerable small cysts. Occasionally single larger cysts are seen having an opalescent milky appearance.

CHRONIC ANTERIOR URETHRITIS.—**SOFT INFILTRATION.**—*Mucous Membrane.*—Hyperemic areas surrounded by healthy mucous membrane. Erosions are sometimes seen. Granular patches are found on floor of bulbous urethra. Thickening is shown by large puffy folds projecting upward into the field. The lumen is gaping or closed, having an irregular crescentic appearance (Fig. 22, 11 and 15).

Glands.—The crypts and glandular openings are not seen if imbedded in the hyperemic areas. Those in the paler areas appear as red elevations discharging pus.

HARD INFILTRATION: GLANDULAR FORM.—*Mucous Membrane.*—Paler in color, surface appears uneven.

Glands.—Glands of Littre surrounded by a red areola. Openings enlarged, crater-like, or plugged with secretion. Crypts of Morgagni swollen and gaping, discharging mucopurulent secretion.

HARD INFILTRATION: DRY OR FOLLICULAR FORM.—*Mucous Membrane.*—Diseased areas are grayish or yellowish white.

Glands.—Very few glands seen. This is very characteristic of the dry stage. The glands and crypts being either obliterated or converted into sub-epithelial cysts.

Very frequently both glandular and dry forms are seen in the same urethra. This Oberlaender calls "mixed infiltration."

SUBACUTE ANTERIOR URETHRITIS.—*Mucous membrane* is red and velvety. The vascular streaks are lost. The mucosa is thrown into thickened folds. The openings of the *glands* and *crypts* are red, swollen, and exude pus.

SUBACUTE POSTERIOR URETHRITIS.—Surface is dark red and swollen and sometimes eroded. Occasionally follicular abscesses are seen as small yellowish elevations. The *verumontanum* is red and swollen.

Ulcers.—Ulcers are usually of traumatic origin, resulting from instrumentation. They may, however, be tuberculous. They are most frequently found in the floor of the bulbous urethra. Their borders are irregular with red or grayish necrotic bases.

Polypi.—Polypi are seen most frequently in the anterior urethra. They appear as smooth, oval, pedunculated bodies, varying from pale pink to dark red in color (Fig. 22, 12).

Papillomata.—Two varieties of papillomata are seen in the urethra: (1) flagellated; (2) flat sessile. The first variety is found most frequently in the deep urethra on or near the sphincteric margin, or springing from the colliculus (Fig. 22, 13). The sessile tumors have a raspberry appearance. They occur most frequently in the anterior urethra just within the meatus. In one case of congenitally contracted hypospadiac meatus the first half inch of the urethra was almost occluded by these growths (Fig. 22, 14).

Calculi.—Calculi found lying in the urethra are nearly always of renal origin, having been passed into the bladder and after a varying time entered the urethra and passed through it or been caught at some narrow point of the canal. They are found most frequently in the prostatic or bulbous urethra or in the fossa navicularis when the meatus is small. In Guiteras' case there were 4 stones found in the pendulous urethra. O'Crowley has reported one in which the bulbous and prostatic portions of urethra were distended with calculi.

Calculi sometimes originate in the parenchyma of the prostate; these gradually enlarge and if near the urethral mucosa break through and either are passed or become caught and require removal. Sometimes the prostatic stone is quite large and remains firmly imbedded in the prostatic tissue and, gradually increasing in size, it may break through the urethra; further deposition of salts causes the urethral portion to enlarge, the stone then having an hour-glass or dumb-bell shape.

Foreign bodies are rarely found in the male urethra. Bits of catheter, pencils, and pen-holders have been reported.

Solitary cysts of non-infectious origin are seen but rarely. They have been found in the deep urethra near the sphincteric margin (Fig. 22, 16).

Chancre and chancroid of the urethra occur most frequently just within the meatus and can usually be seen without the aid of the urethroscope.

Prostatic Hypertrophy.—That portion of the posterior urethra lying between the verumontanum and vesical sphincter normally has a cylindrical appearance. In beginning hypertrophy its transverse diameter becomes narrowed, due to the projection of the enlarged lateral lobes of the prostate into the urethra. In advanced hypertrophy this narrowing becomes more marked, giving the urethra the appearance of a vertical slit, slightly wider near the urethral floor. The internal vesical sphincter, instead of being round, assumes the same shape (Fig. 22, 17-19).

TECHNIC OF URETHROSCOPIC TREATMENT

Urethroscopic treatment comprises (1) local applications of medicinal agents; (2) incision of cysts; (3) electrolysis of diseased glands, crypts, and

papillomata; (4) fulguration; (5) galvanocauterization; (6) removal of calculi and foreign bodies.

Local Applications.—The drugs employed are:

1. Solution of silver nitrate, $\frac{1}{2}$ to 25 per cent.
2. Silver nitrate fused on metal applicator.
3. Equal parts of iodine crystals and carbolic acid.
4. Solution of equal parts tincture of iodine and glycerin.
5. Solution of copper sulphate, 5 to 20 per cent.
6. Trichloroacetic acid, 5 to 10 per cent.

Silver nitrate up to 5 per cent. is astringent, absorbent, and stimulates the proliferation of epithelial cells. When used stronger than 5 per cent., it begins to have caustic properties which are marked at 20 per cent. and very active when applied in the fused state. Trichloroacetic acid and the iodized carbolic acid mixture are both caustic. Tincture of iodine and glycerin have absorbent properties. Copper sulphate up to 10 per cent. is astringent and quite caustic at 20 per cent.

These drugs are applied by means of swabs made by winding cotton around the spiral ends of metal applicators. The swab should be about $\frac{1}{2}$ in. long and $\frac{1}{8}$ in. thick. When caustic solutions are used, a very fine applicator is selected and just a wisp of cotton firmly rolled around its end. When using silver nitrate in the fused state, it is prepared as follows: Hold a stick of caustic against the end of the applicator over a Bunsen burner, rotating the applicator until enough silver is fused to its point.

If the posterior urethra is to be treated, use the largest sized Guiteras' tube or my tube with beaked obturator. After the instrument is passed into the bladder, withdraw the obturator and wipe the field dry with applicators. If there is much fluid present, aspirate it by passing a small catheter, attached to a small rubber bulb, into the tube. Attach the illuminating device and turn on the electric current. Draw the tube forward until the lesion is located. Steady the tube with the left hand, dip the applicator into the solution, and, passing it through the tube, apply it to the diseased area.

If the anterior urethra is to be treated, use the Guiteras' tube or my tube with straight obturator. Pass the instrument down to the lesion, remove obturator, and make application as described (Fig. 23).

For localized areas of hyperemia use weak solutions of silver, beginning with 2 gr. to the ounce, increasing 1 gr. each time up to 10 gr. For erosions and ulcerations use 1 to 2 per cent. silver nitrate solution. Granulations require stronger solutions: Begin with 10 per cent. and increase up to 25 per cent. if necessary, making applications every 5 days. Sometimes it is necessary to use fused silver to destroy them. Copper sulphate, 10 to 20 per cent., and iodized carbolic acid are also effective caustics. I have had best results with silver. Dilated chronically inflamed glands and crypts can be destroyed by injecting them with 1 drop of iodized carbolic acid or 20 per cent. silver nitrate through a cannula or, better still, by first slitting them open and then cauteriz-

ing with fused silver. If electricity is not available, papillomata and polypi may be removed with a snare, after which the base may be cauterized with silver or iodine and carbolic. In irritable impotence and chronic posterior urethritis, where the colliculus shows marked involvement, excellent results are obtained by painting the colliculus with 20 per cent. silver, iodine and carbolic, or trichloroacetic acid, 5 to 10 per cent.

Intervals between treatments will depend on the severity of reaction follow-

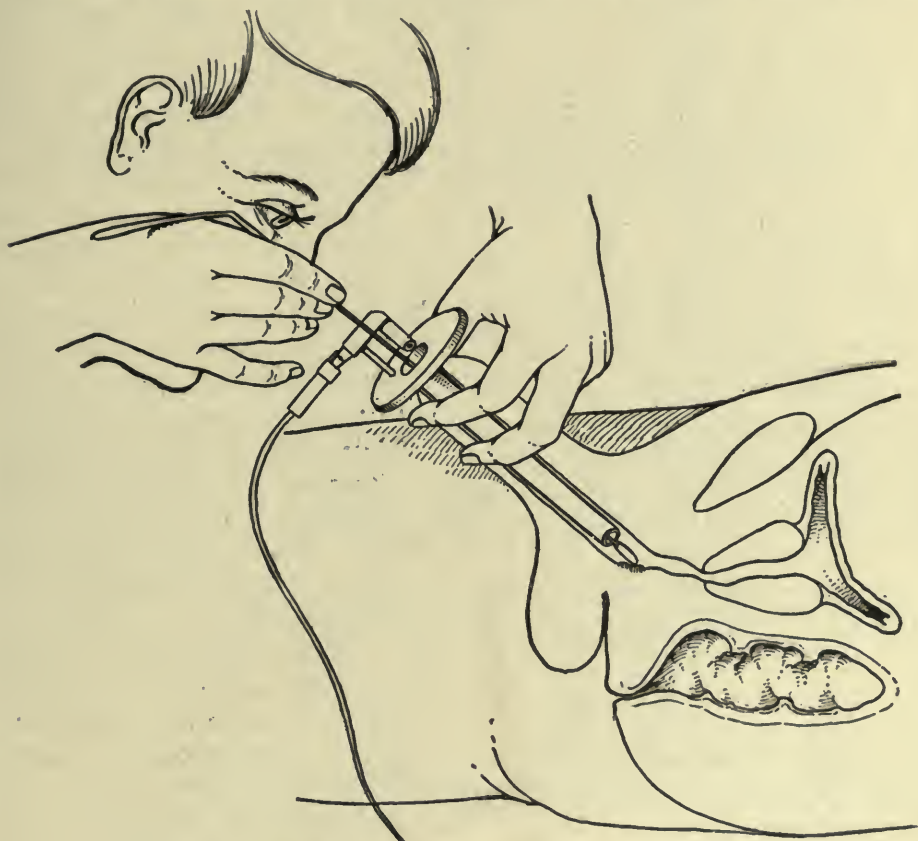


FIG. 23.—METHOD OF MAKING APPLICATIONS TO THE URETHRA.

ing an application. A mild reaction is characterized by increased discharge and slight pain on urinating, lasting from 12 to 24 hours. When the reaction is severe, there are, in addition, frequent and painful urination and sometimes terminal bleeding. No treatment should be repeated until the reaction has completely subsided. In a general way, when mild solutions are employed, they can be repeated in 2 or 3 days. Stronger solutions are repeated in from 5 to 10 days.

Incision of Cysts and Glandular Ducts.—Use either the Buerger or the direct-view irrigation urethroscope. The handle of the knife consists of a long, slender, flexible metal rod. The parts are assembled by introducing the handle end

of the knife through the inner opening of the catheter outlet on the telescope, from within outward (Fig. 24). The catheter outlet is provided with a perforated rubber cap. The knife is then passed through far enough so that its blade will not project beyond the end of the tube when the telescope is introduced into the sheath. After introducing the sheath and withdrawing the obturator, insert the telescope with attached knife. Turn on fluid and illumination.

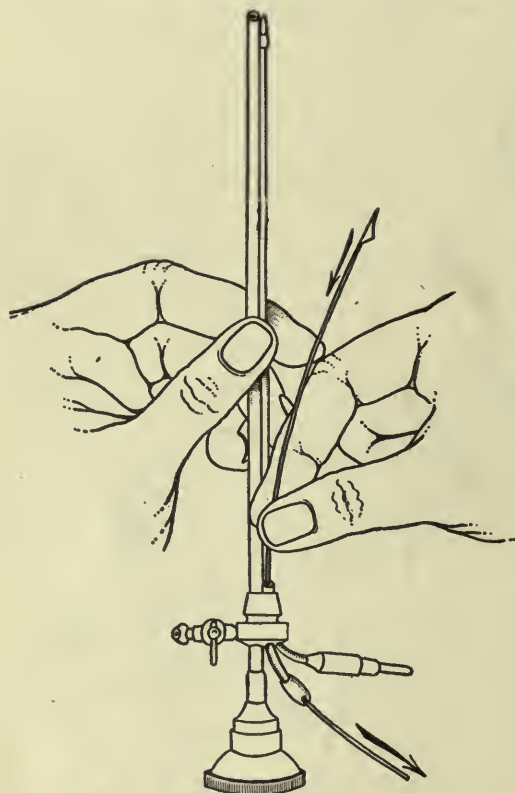


FIG. 24.—SHOWING HOW THE KNIFE IS THREADED THROUGH THE CATHETER CHANNEL OF AUTHOR'S URETHROSCOPE.

After locating the lesion, the knife is slowly pushed forward until it appears in the image. The cyst or duct is incised by first piercing the cyst wall and then enlarging the incision by moving the ocular end of the instrument upward and downward or from side to side (Fig. 25). Simple rotation of the shaft brings the knife within reach of the lesion. If the Buerger instrument is used, the knife is guided to the cyst or duct by means of a deflector controlled by 2 screws on the distal end of the telescope. If the cyst is on the roof of the canal, the shaft must be rotated so that the fenestra looks upward.

Cysts can also be incised through an ordinary urethroscopic tube. Use the straight tube with the beaked obturator for the posterior urethra. Insert the tube with the obturator. After locating the lesion, incise through

the tube with a knife having a rigid handle. After incising, cauterize with silver fused on an applicator or with iodin and carbolic (Fig. 26).

Electrolysis of Chronically Inflamed Glands, Cysts and Papillomata.—Electrolysis is an effective method of destroying these lesions. It can be performed through an irrigation urethroscope or through a straight tube without water dilatation. If the lesion is in the posterior urethra, use either the Buerger or the direct-view instrument. After the lesion is located, insert a flexible electrolysis needle through the catheter outlet, upon which a perforated rubber cap has been placed. The needle is pushed forward until it appears in the image, after which it is passed into the duct, cyst or base of the tumor, using the same technic in guiding the needle as described under incision of cysts.

The needle is connected with the negative pole of a galvanic battery, while the sponge electrode of the positive pole is attached to the thigh. When the current is turned on, minute bubbles escape. An inflammation results which obliterates the gland or cyst, and shrivels up the tumor. The strength of current is from

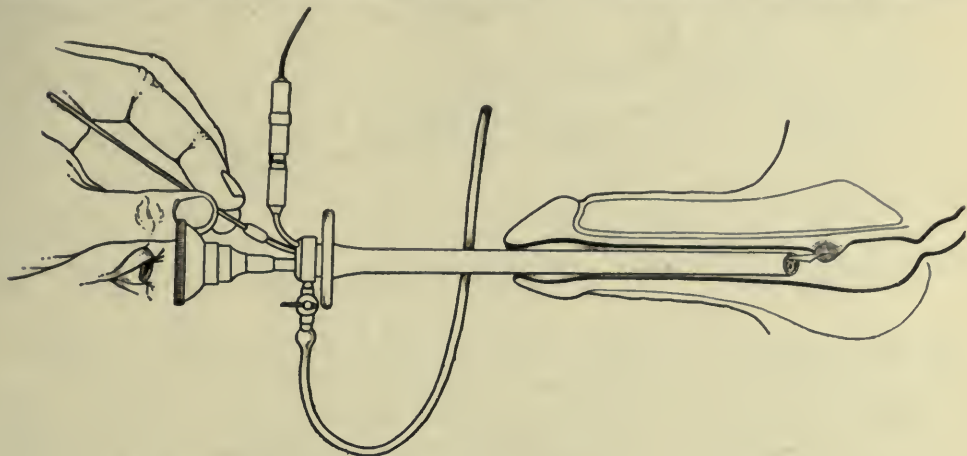


FIG. 25.—INCISION OF URETHRAL CYST THROUGH IRRIGATION URETHROSCOPE.

3 to 10 milliampères and its duration not over a minute. Repeat in 5 to 10 days if necessary. It may require 3 or 4 applications to destroy a papilloma.

If an ordinary urethroscopic tube is used, the same technic is followed except that a rigid needle is employed. The strength of the current is from 3 to 5 milliampères.

Fulguration.—Cysts, papillomata and polypi are painlessly and rapidly destroyed by fulguration. This method is superior to electrolysis. The technic

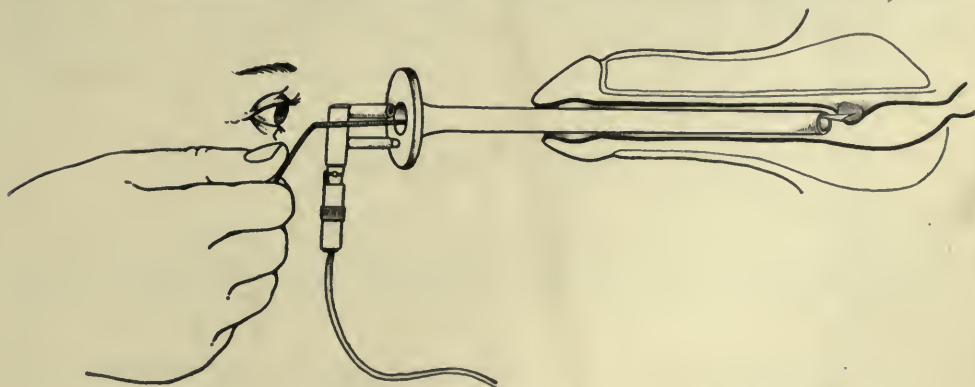


FIG. 26.—INCISION OF URETHRAL CYST THROUGH ORDINARY URETHROSCOPIC TUBE.

is exactly the same as that for electrolysis, except that a fulgurating wire is used instead of a needle, and the high-frequency current instead of the galvanic (see method of fulguration, under Cystoscopy).

Galvanocauterization.—Papillomata and polypi can be effectually destroyed

in this way. Do not use water dilatation. Use the straight endoscopic tube with beaked or straight obturator. After locating the tumor, connect the cautery with the motor and when its point is a bright red pass it through the tube and apply it to the tumor for a second or 2. Do not try to cauterize too



FIG. 27.—REMOVAL OF CALCULUS CAUGHT JUST BEHIND MEATUS WITH RING CURET.

much at a time and be careful not to burn the mucous membrane. Repeat in 1 week if necessary. This method is inferior to fulguration.

Goldschmidt first attempted by galvanopuncture to remove the obstruction caused by the lobes of an hypertrophied prostate projecting into the urethra. Goldschmidt, Schlenzke, and H. Wossidlo have had some success in a small number of cases, but relapses of retention occur, necessitating further treatment

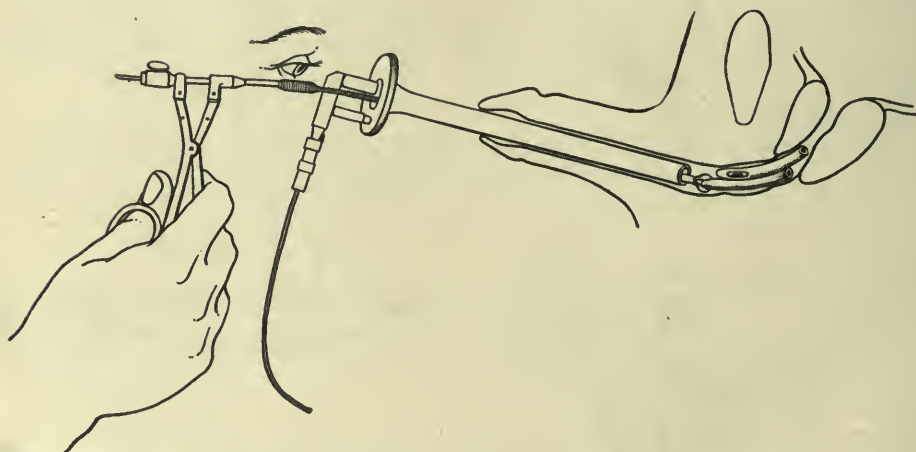


FIG. 28.—REMOVAL OF BROKEN CATHETER THROUGH URETHROSCOPIC TUBE WITH CYSTOSCOPIC FORCEPS.

and rendering difficult a later prostatectomy on account of the dense scar tissue formed. Bugbee uses instead the high-frequency current and claims excellent results.

Removal of Calculi and Foreign Bodies.—If the stone is in the fossa navicularis, do a preliminary meatotomy, if the meatus is small. Remove the stone with a small ring curet (Fig. 27). If the stone or foreign body is in the penile, bulbous, or prostatic urethra, insert the largest sized tube and remove it

with forceps. If the stone is too large, try to chip off fragments with the urethral punch forceps.

INDICATIONS AND CONTRA-INDICATIONS FOR URETHROSCOPY

Indications.—The examination of the urethra with the urethroscope is indicated in chronic relapsing urethritis, in sexual neurasthenia, irritable impotence, and in all conditions in which the symptoms point to the urethra.

Contra-indications.—The urethroscope should never be used for diagnosis or treatment when the urethra is acutely inflamed. This applies especially to acute urethritis and acute exacerbations of chronic urethritis. Appropriate treatment should first be given to reduce the acute inflammation.

In this connection it is important to bear in mind that, although urethroscopic treatment gives excellent results in certain phases of chronic urethritis, it will prove of value only when well-defined local lesions are present, such as hyperemic patches with adherent shreds, erosions, granulations, enlarged chronically inflamed urethral glands or cysts. In chronic posterior urethritis and irritable impotence associated with sexual neurasthenia, in which the urethroscope shows an enlarged, eroded, congested or edematous verumontanum, local treatment through the urethroscope will often give very gratifying results. The same holds true for urethral polypi and papillomata, the urethroscope being essential for their detection and removal. In the management of chronic urethritis the best results are obtained when urethroscopic treatment is used in conjunction with the older well tried methods of treatment, such as massage, irrigations and dilatation with sounds and Oberlaender and Kollmann dilators. Exact diagnosis and careful study will determine the course of procedure in a given case.

URETHRAL FEVER

This can usually be prevented by washing out the urethra with 1 to 6,000 silver nitrate solution after examination and giving urotropin or salol gr. 10 t. i. d., p. c., for 24 hours following. In nervous patients who bear instrumentation badly, give, in addition, a rectal suppository containing morphin sulphate, gr. $\frac{1}{4}$, and quinin sulphate, gr. 10.

STERILIZATION AND CARE OF INSTRUMENTS

Endoscopic tubes, obturators, and endo-urethral instruments are sterilized by boiling for 5 minutes. The sheaths of the Buerger and Goldschmidt irrigation urethroscopes, light carriers, lamps and telescopes can be rendered sterile by placing in 2 per cent. lysol for 10 minutes, rinsing in alcohol and water, and wiping dry with sterile

gauze. The complete outfit can be sterilized with formalin vapor (see Cystoscopy).

The life of the urethroscopic lamps will be materially lengthened if they are tested before examination and the amount of current necessary for illumination determined. Sometimes the light suddenly goes out during the examination. This is due either to burning out of the lamp or to the entrance of water into the screw joint connecting the lamp with the lamp carrier. In either case remove the light carrier before turning on more current. If the lamp is not burnt out, unscrew it from the light carrier and remove any fluid with gauze or cotton. If, after wiping the lamp and its connection, it does not light and has in addition a black color, it is burned out and must be replaced by a new one.

Sometimes the urethroscopic image appears as a uniform, dimly lighted, red area, showing nothing. This is usually due to blood deposited upon the telescopic lens and not because of insufficient light. Before turning on more current and burning out the lamp, withdraw the telescope and, if blood is present, wipe it off.

URETHROSCOPIC OUTFIT

1. Urethroscopes.—One of the following:

Goldschmidt irrigation urethroscope.

Buerger cysto-urethroscope.

Direct-view irrigating urethroscope with accessory tubes.

If the Buerger or Goldschmidt instruments are used, it is advisable to have a set of straight tubes, of the Guiteras or Young's type, for making local applications. The reader will find my own direct-view urethroscopic outfit (Fig. 15) a very complete one for diagnosis and treatment.

2. Electrical Apparatus.

Street current or portable battery.

High-frequency machine.

Rheostat.

Fulgurating wire.

Electrolysis needle (flexible or rigid).

Galvanic cautery.

3. Endo-urethral Instruments.—(Fig. 29).

Metal applicators, 10 in. long, with spiral ends.

Knife on flexible handle (for irrigation urethroscope).

Knife on rigid handle.

Forceps.

Ring curet.

Polypus snare.

Filiform probe.

Injection cannula.

Ultzmann instillation syringe.

Blunt-pointed glass urethral syringe.

4. Examining table provided with steel stirrups and irrigating jar with rubber tubing.

5. Solutions.—Sol. silver nitrate, $\frac{1}{2}$ to 25 per cent.

Sticks or lunar caustic.

Sol. of equal parts iodine crystals and carbolic acid.

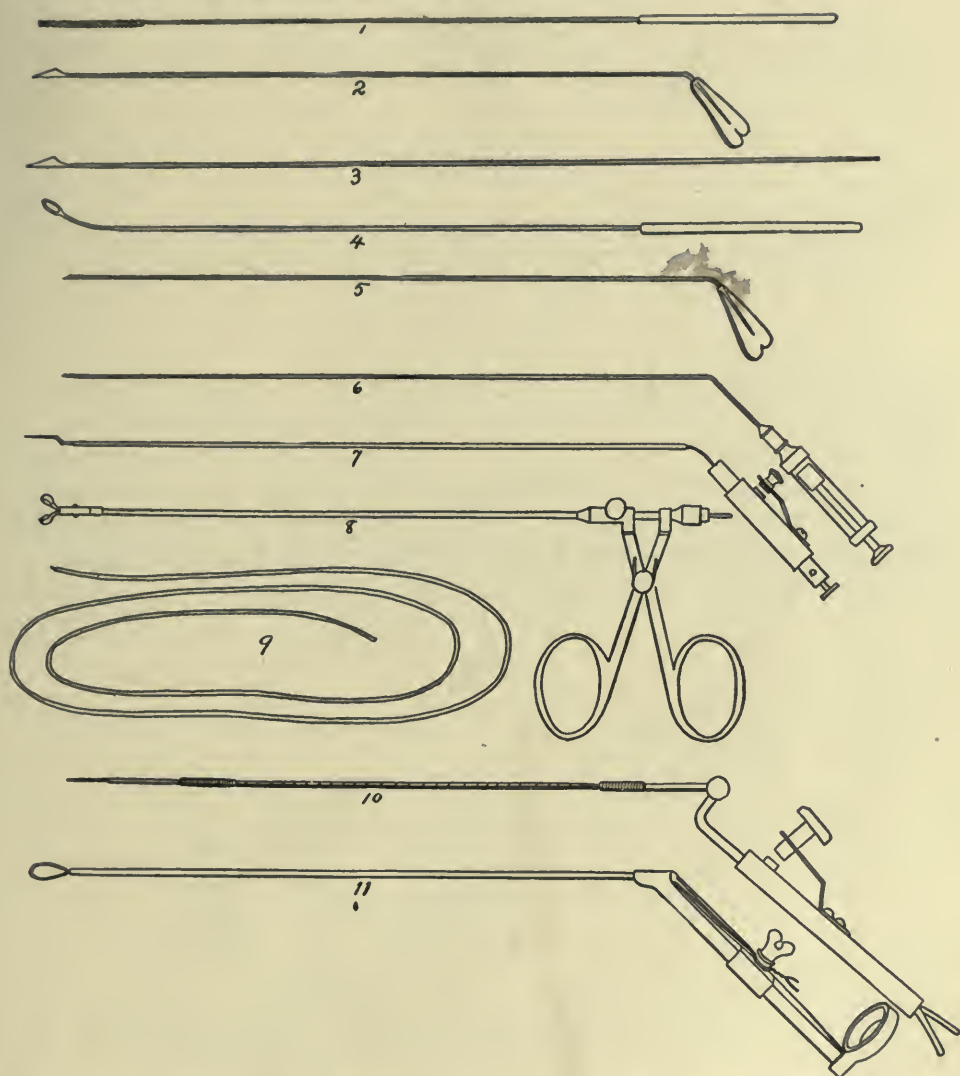


FIG. 29.—ENDO-URETHRAL INSTRUMENTS. 1—Applicator; 2—knife with rigid handle; 3—knife with flexible handle; 4—ring curet; 5—probe; 6—syringe and injection cannula; 7—electrolysis needle; 8—cystoscopic forceps; 9—fulguration wire; 10—galvanocautery needle; 11—cold wire snare.

Sol. of equal parts tincture of iodine and glycerin.

Sol. copper sulphate, 5 to 20 per cent.

Trichloroacetic acid, 5 to 10 per cent.

Glycerin.

Sol. cocain, beta-eucain, 2 per cent., novocain, or alypin, 4 per cent.

Cotton.

TECHNIC OF CYSTOSCOPY, CATHETERIZATION OF THE URE-
TERS, AND INTRAVESICAL OPERATIVE PROCEDURES
WITH THE CYSTOSCOPE

CHAPTER V

TECHNIC OF CYSTOSCOPY, CATHETERIZATION OF THE URETERS, AND INTRA-VESICAL OPERATIVE PROCEDURES WITH THE CYSTOSCOPE

DAVID GEIRINGER

Since 1880, when Nitze introduced the first electric cystoscope which enabled the surgeon to make a visual examination of the interior of the bladder, cystoscopy has developed to such an extent that today it is the essential method of diagnosis in the majority of urinary diseases. Although there are a few diseases of the bladder in which valuable information cannot be gained by the cystoscope, there are many in which a correct diagnosis cannot be made without it. In disease of the kidney, cystoscopy gives information that could not be ob-

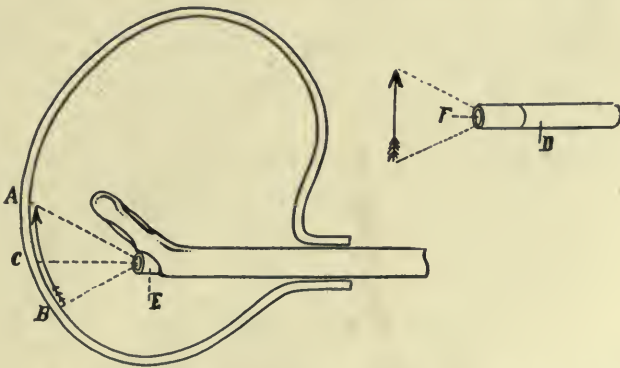


FIG. 1.—A DIRECT CYSTOSCOPE IN BLADDER SHOWING FIELD OF VISION. A-B, Field of vision; C, central point of field of vision; E, end of direct telescope projecting out of cystoscopic sheath; F, window of telescope.

tained by any other method. By ureter catheterization the functional value and the presence or absence of disease of one or both kidneys are determined. The location of an obstruction in the ureter can be ascertained by the passage of a graduated ureter catheter, or the relation of a doubtful radiographic shadow to the ureter may be determined by the passage of a catheter opaque to the X-ray. Finally, the injection of fluids (argyrol, collargol) which are impermeable to the X-ray, into the pelvis and ureter, followed by radiography (pyelography) has proven of great value in showing the position and mobility of the kidney and the size of the renal pelvis.

GENERAL DESCRIPTION OF CYSTOSCOPES

The cystoscope consists essentially of 2 parts: (1) a metal tube or sheath, one end of which is provided with an elbow or beak to facilitate the introduction of the instrument into the bladder; (2) a telescope through which the bladder is inspected.

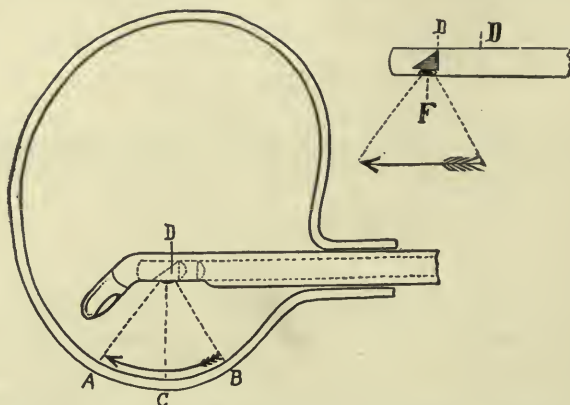


FIG. 2.—AN INDIRECT CYSTOSCOPE IN BLADDER. A-B, Field of vision; C, center of visual field; D, prism contained in telescope; F, window of telescope.

The source of illumination is a small, cold incandescant lamp fixed in the beak of the sheath.

There are 2 general classes of cystoscopes depending upon the lens system employed in the telescope. They are the direct and the indirect or prismatic.

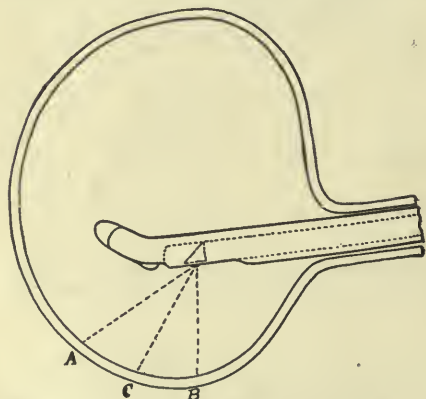


FIG. 3.—OBLIQUE VIEW CYSTOSCOPE IN BLADDER. A-B, Visual field; C, center of visual field; instead of being at right angles to the shaft of the cystoscope, it is placed anterior to it.

Direct Cystoscopes.—In this form, the lenses of the telescope are so arranged that the line of vision is parallel to the long axis of the sheath, the interior of the bladder being viewed through a window at the distal end of the telescope. Only that part of the bladder directly in front of the lens is seen (Fig. 1).

Indirect Cystoscopes.—In this type the line of vision is at right angles to the long axis of the sheath. A prism deflects the rays of light at an angle of 90° . The window (A) is situated on the side of the telescope near its distal end. When looking through this telescope only that part of the bladder at right angles to the axis of the sheath is seen.

There are 2 other types of prismatic telescopes: the oblique and the retrograde.

Oblique View Telescopes.—In this telescope the rays of light are deflected about 115° instead of 90° . The central point of the field of vision, instead of being at right angles to the sheath, is situated just a little forward. These telescopes are used only

in catheterizing cystoscopes and will be described later in this connection. The accompanying diagram explains these differences (Fig. 3).

Retrograde View Telescopes.—These were devised in order to see the vesical neck more clearly. There are several varieties. The Schlagenweit instrument consists

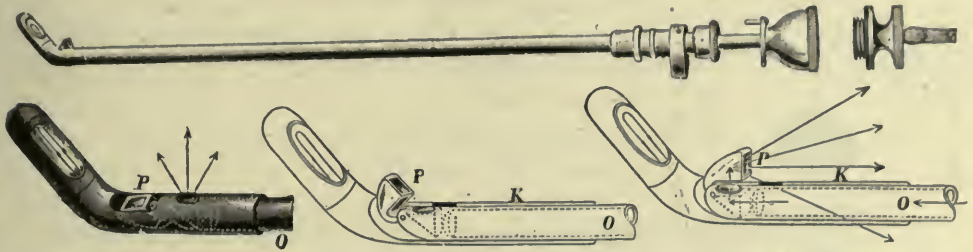


FIG. 4.—SCHLAGENWEIT RETROGRADE CYSTOSCOPE. P, Prism which superimposes itself over the prism contained in the telescope, when the telescope O is advanced into the sheath K.

of an indirect telescope which has attached to its distal extremity a second prism which is movable. By merely pushing the telescope into the sheath the second prism superimposes itself over the prism in the telescope and looks directly at the vesical neck (Fig. 4). In another variety the movements of the second prism are controlled by a screw at the ocular end of the telescope. In the Bransford-Lewis retrograde telescope this prismatic arrangement is entirely within the telescope.

Cystoscopes are also classified according to the particular purpose for which they were constructed.

1. Observation Cystoscopes.—

These are all of the indirect type and are used only to inspect the interior of the bladder.

2. Catheterizing Cystoscopes.

—These may be either of the direct or indirect type and are designed for ureter catheterization.

3. Composite Cystoscopes.

—These cystoscopes are provided with direct, indirect and retrograde telescopes for examination and catheterizing telescopes for ureter catheterization.

4. Operating Cystoscopes.

5. Photographing Cystoscopes.—These are complex instruments which are used by but few urologists. A great deal of time and practice are necessary to operate them and the pictures are often unsatisfactory. The reader is referred to the original article by Nitze.

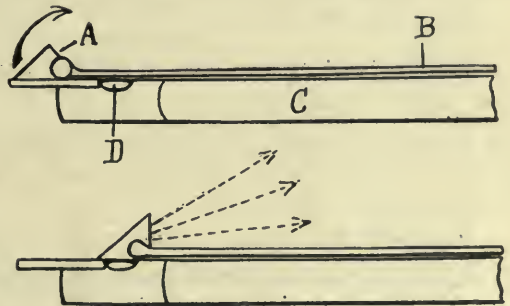


FIG. 5.—RETROGRADE TELESCOPE OF AMERICAN MAKE. A, Movable prism; B, rod connected with screw on handle by means of which the prism is moved; C, shaft of telescope; D, lens window of the telescope.

CYSTOSCOPIC EXAMINATION OF THE BLADDER

If the interior of a phantom bladder or a hollow sphere be examined with both a direct and indirect telescope, it will be found that, although certain areas

are seen with good illumination and definition with each, other areas show up less distinctly or not at all.

With the indirect telescope, for example, the neck of the bladder cannot be seen with any degree of clearness, the image being poorly illuminated and very much magnified and distorted (Fig. 6, B, C). There is also a small round area, about $\frac{3}{4}$ in. in diameter, on the posterior wall just above the fundus, which can be viewed only at long range because the beak interferes with close vision; the image being not well defined and poorly illuminated (Fig. 6, A).

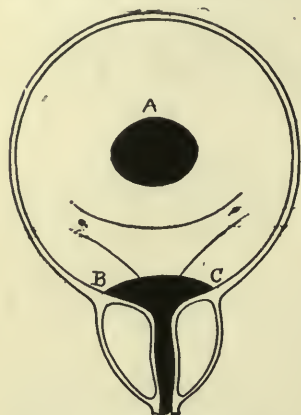


FIG. 6.—SHOWING AREAS OF BLADDER NOT CLEARLY SEEN WITH INDIRECT TELESCOPE. Unshaded portions are distinctly seen.

With the direct telescope much less of the bladder can be seen. The unshaded portion of the accompanying diagram (Fig. 7) shows the parts of the bladder which can be seen with a direct telescope. These include the lower portions of the posterior and lateral walls, the vesical fundus, and approximately the posterior $\frac{2}{3}$ of the trigone. The area A in Figure 6 can be clearly seen. In cases of prostatic hypertrophy with intravesical projection the fundus cannot be clearly seen and very often the ureters are not found.

The entire interior of the bladder, with the exception of the vesical neck, can be examined with the direct and indirect telescopes. To see this last-mentioned area the retrograde telescope is necessary, but, although it gives a better view of the vesical neck than the indirect telescope, the image is by no means perfect.

Composite Cystoscope.—From the foregoing it is evident that in order to obtain the best possible view of the entire bladder it must be examined with the direct, indirect, and retrograde telescopes. These different telescopes are all included in the so-called composite cystoscopes of which the Bransford-Lewis Universal cystoscope is an excellent example.

This composite cystoscope has the usual elbowed sheath, 25 French (Fig. 8, A), which is fenestrated on the concavity of the beak for the indirect (F) and retrograde (D) telescopes and on the convexity for the direct telescope (E). It is equipped with both direct and indirect catheterizing telescopes (B and C).

If the composite cystoscope is not available, or if it cannot be used on account of its large caliber, the Nitze and the Wappler observation cystoscopes will

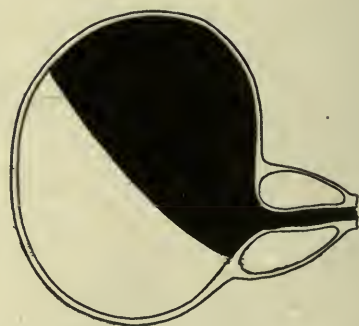


FIG. 7.—PART OF BLADDER WHICH CAN BE SEEN WITH DIRECT TELESCOPE. The shaded portion including the region around the vesical neck and the upper zones cannot be seen.

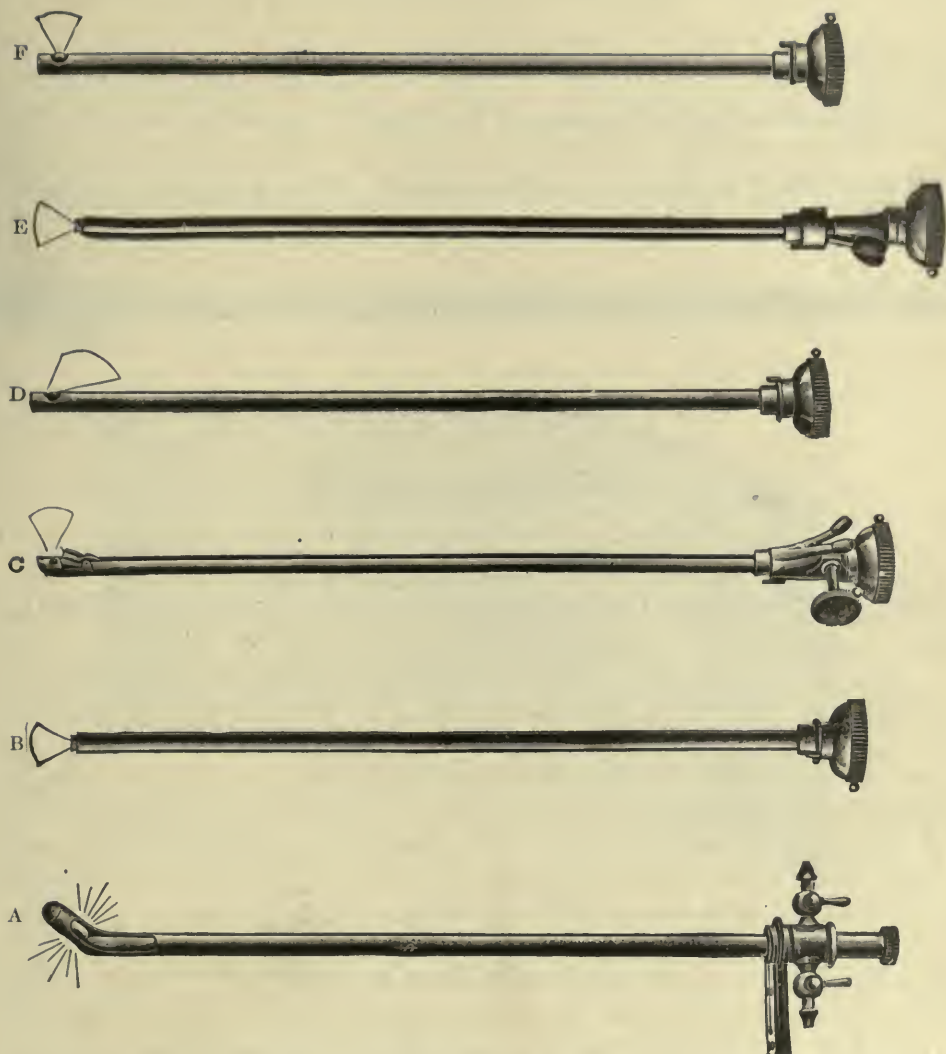


FIG. 8.—BRANSFORD-LEWIS UNIVERSAL CYSTOSCOPE. A, Cystoscopic sheath with obturator and electric coupling; B, direct catheterizing telescope; C, indirect catheterizing telescope; D, retrograde telescope; E, direct telescope; F, indirect telescope.



FIG. 9.—WAPPLER INDIRECT EXAMINING CYSTOSCOPE.

be found useful instruments because of the small sizes in which they can be obtained.

Wappler Observation Cystoscope.—The Wappler observation cystoscope (Fig. 9) consists of a metal sheath ranging in size from 13 to 18 French. Its distal extremity, which is elbowed, contains the lamp. In the concavity of the beak is a small window through which the bladder may be irrigated or viewed when the

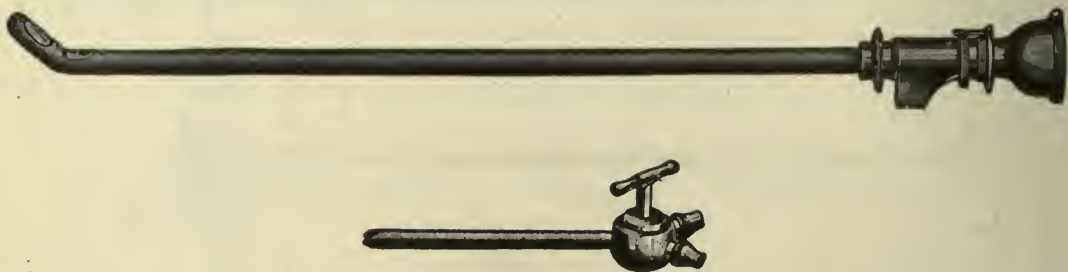


FIG. 10.—NITZE INDIRECT EXAMINING CYSTOSCOPE.

telescope is in position. At the ocular extremity is a lock or clutch for holding the telescope firmly in place.

The telescope serves also as the obturator. The optical system is of the indirect prismatic variety, through which upright right-angled images are seen.

The small sizes in which this instrument can be obtained make it a very useful one in examining children or adults having a small urinary meatus or when stricture is present. Likewise, in cases where the cut-off muscle or neck of the bladder is irritable or when the deep urethra is distorted, as in prostatic hypertrophy, a small instrument of this type can often be passed into the bladder when it is impossible to introduce cystoscopes of larger caliber.

Nitze Observation Cystoscope.—The Nitze observation cystoscope (Fig. 10) is very similar to the Wappler instrument. Its caliber is 21 French. Irrigation is performed in the same way except that with this instrument there is provided a short tube with an automatic 2-way valve which is inserted into the sheath after the telescope is withdrawn. The irrigator is connected to one of the outlets of the valve and the flow is turned on. When the bladder is full the telescope is introduced into the sheath, the current is turned on, and the examination begun.

The irrigation tube with the automatic valve is apt to prove cumbersome and offers no advantage over the simpler method of irrigation employed in the Wappler instrument.

Equipment.—The following instruments and apparatus are necessary for cystoscopic examination and ureter catheterization:

1. Cystoscopes with cords, extra lamps and ureteral catheters.
2. Street current or portable battery and rheostat.
3. Ultzmann or Keyes instillation syringe.
4. Blunt-tipped glass urethral syringe.

5. Small piston syringe holding from 5 to 10 c. c., having a needle which fits into the ends of the ureteral catheters.
6. A glass irrigator with rubber tubing and tip, or Janet-Frank syringe, 150 c. c.
7. Table with lithotomy uprights or Bierhoff crutches. (If table is not provided with drainage, use Kelly pad.)
8. Sterile towels.
9. Cotton sponges.
10. A small test glass.
11. Basin filled with 1:2,000 bichlorid colored blue or red.
12. Solution cocaine 2 per cent., novocain 4 per cent., or alypin 2 per cent.
13. Urotropin tablets, grs. viiss.

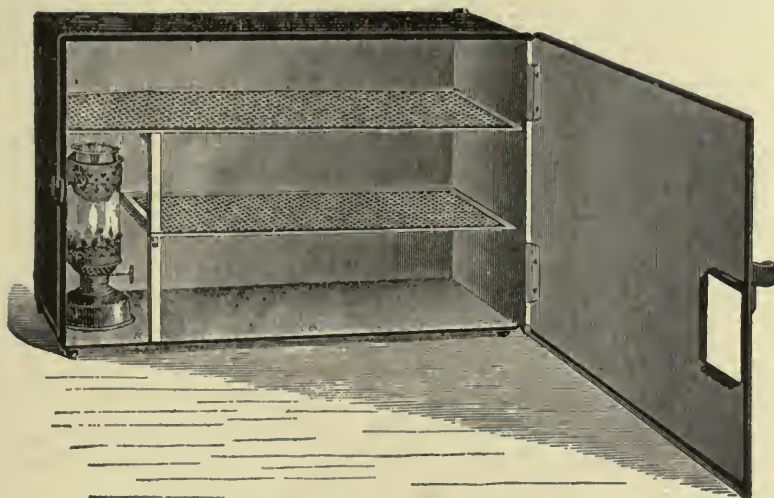


FIG. 11. —FORMALIN STERILIZER.

14. 1 oz. bottle solution silver nitrate 100 per cent.
15. Tincture green soap.
16. Wide-necked jar containing glycerin.
17. Specimen urine bottles labeled "right" and "left."
18. Soft rubber and woven coudé catheters, sizes 12 to 16 French.
19. Suppositories containing morphin sulphate gr. $\frac{1}{4}$, quinin sulphate grs. 10, cacao butter gr. xv.

Sterilization.—The various parts of the cystoscope should be taken apart and cleaned with green soap and water. Sterilization is completed by immersion in 95 per cent. alcohol and rinsing in sterile water; or the instrument may be placed in 2 per cent. lysol or 2 per cent. formalin solution for 15 minutes and rinsed in sterile water. The formalin solution is made by adding 1 oz. of Holzien's solution to 1 qt. of water. (Holzien's solution consists of formalin 60 parts and alcohol 40 parts.) The entire instrument can be sterilized by placing it in a formalin cabinet of the Shering and Glatz type (Fig. 11) for at least $\frac{1}{2}$ hour.

Ureteral and woven silk urethral catheters are sterilized by first flushing them with 2 per cent. lysol or formalin solution or in 1:1,000 oxycyanid of mercury. They are then placed in these solutions for 15 minutes, after which they are again flushed out and rinsed in sterile water.

Soft rubber catheters, syringes and glassware are sterilized by boiling. Basins and

enameled ware are placed in 1:1,000 bichlorid for 15 minutes and rinsed in sterile water.

After sterilization, the instruments and solutions should be laid on a table covered with a sterile towel. If catheterization is to be performed, the catheters should be inserted into the catheter outlets, which are capped with perforated rubber tips to prevent leakage during catheterization.

As cystoscopy and ureter catheterization are always more or less painful procedures for the patient, it is necessary, in order to insure a successful examination, to place the subject in a comfortable position and to move the instrument about gently after introduction into the bladder. The surgeon should have everything within reach of the right hand. He is thus able to hold the instrument in position with the left hand and perform the necessary manipulations with the right. Leaving the patient alone, if only for a moment, after the cystoscope is introduced, is bad practice; the patient may become alarmed or a sudden contraction of the bladder may force the instrument through the deep urethra, necessitating re-introduction.

Preparation of the Patient.—After emptying his bladder, the patient is placed on the table in the reclining position, with the head and shoulders slightly elevated. The clothing of the lower extremities is removed and replaced with leglets.

The external genitals are washed with green soap and water followed by 1:3,000 bichlorid or oxycyanid solution. The surgeon then scrubs up and disinfects his hands in the same solutions.

Anesthetizing the Urethra and Bladder.—In moderately sensitive patients sufficient anesthesia can be obtained by instilling 30 minims of 1 per cent. cocain into the bladder and deep urethra with an Ultzmann syringe and distending the anterior urethra with the same solution, retaining it for 5 minutes. If the posterior urethra is very sensitive, instill 30 minims of a 1 per cent. cocain solution into the bladder, 10 drops of a 4 per cent. solution into the deep urethra, and 1 per cent. for the anterior urethra. (See Urethroscopy.)

Alypin is a safe reliable non-toxic anesthetic. As much as 20 c. c. of a 2 per cent. solution can be injected into the urethra and bladder without toxic effects. Anesthesia lasts about 30 minutes.

Guyon's solution is sometimes used instead of cocain. It consists of anti-pyrin, grs. xv; laudanum, min. x; water, oz. iii. This is injected into the rectum 45 minutes before examination. It usually produces enough anesthesia to dispense with cocain, but is less reliable than the latter.

Introduction of the Cystoscope.—Before introducing the cystoscope, it should be connected with the rheostat and the lamp tested. If, after turning on sufficient current, the lamp fails to light, it may be burnt out and should be replaced by a new one. If not burnt out, the fault may lie in the contact of the lamp with the instrument, which is remedied by unscrewing the beak and adjusting the conducting portions so that they touch. Failure to light may be also due to short-circuiting caused by the entrance of water in the lamp chamber of the beak. This is avoided by covering the screw of the beak with vaselin before screwing it in place. The connecting cables and the rheostat should also

be tested. The amount of current for illumination should always be determined beforehand, thereby prolonging the life of the lamp.

Having tested the instrument, the obturator is inserted into the sheath, which is then dipped into sterile glycerin and passed into the bladder, using the same technic as employed in passing sounds.

The instrument usually passes into the bladder without difficulty. Occasionally, however, when the deep urethra or bladder is inflamed or irritable, spasm of the cut-off muscle or internal vesical sphincter may obstruct its passage. The surgeon should not attempt to push the instrument through forcibly, as hemorrhage and traumatism will result. By holding the instrument steady and exerting gentle pressure against the opposing muscle, at the same time having the patient breathe rapidly and making firm downward pressure

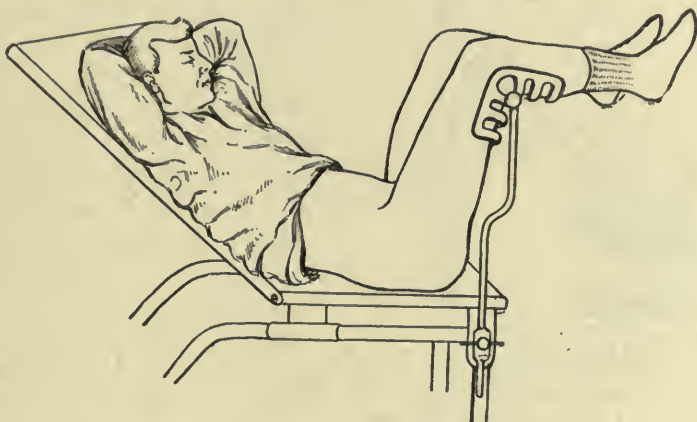


FIG. 12.—POSITION OF PATIENT FOR CYSTOSCOPY.

on the pubes, the spasm will slowly relax and the instrument will glide into the bladder. An enlarged prostate may act as an obstruction, the deep urethra being so distorted that it is impossible to pass a rigid instrument through it. I have met with several such cases, in which it was impossible to enter the bladder without inflicting much traumatism, even under the influence of a general anesthetic. On the other hand, a flexible catheter often enters easily. These cases are fortunately, however, very rare.

If the meatus is small, meatotomy should be performed. If stricture is present, it should be dilated sufficiently to admit the cystoscope.

After the cystoscope is introduced, the patient's legs are supported in lithotomy stirrups or on Bierhoff crutches. The foot piece of the table is then lowered. The patient's buttocks should be about 3 in. from the edge of the table (Fig. 12). During this change in position the cystoscope should be held gently but firmly in position.

Some urologists prefer to put the patient in the cystoscopic position before introducing the cystoscope. Others prefer the sitting position for the patient, on the ground that it is more comfortable. My experience has been that fewer

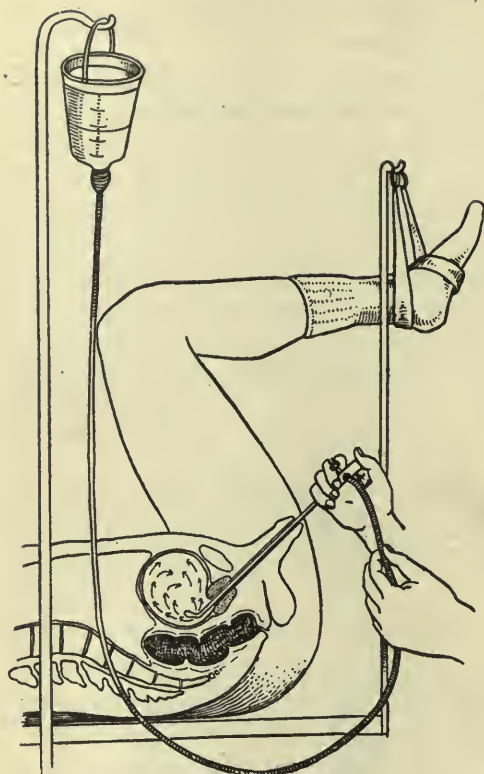


FIG. 13.—WASHING OUT BLADDER. The fluid from the irrigating jar is flowing through the faucet of the cystoscopic sheath into the bladder. To prevent its escape, the thumb is held over the end of the sheath.

difficulties are encountered when the instrument is introduced with the patient in the reclining position.

Washing and Filling the Bladder.

—The instrument having been introduced, washing out the bladder and filling it for examination constitute the next step. The irrigator, filled with warm boric solution, prepared by dissolving 1 oz. of boric acid in a quart of water, is placed about 3 ft. above the patient's pelvis. The tube of the irrigator is then connected with one of the faucets on the distal end of the sheath. Steadying the sheath with the left hand, the surgeon withdraws the obturator and places it on the table. Closing the distal end of the sheath by placing the thumb over it, he opens the faucet and fills the bladder. If there is much pus in the urine, the bladder is alternately filled and emptied until the washings are clear, as shown by collecting some of the fluid and holding it up against the light in a test-glass. The bladder is then filled for examination (Figs. 13 and 14).

As the capacity of the bladder varies in different patients, the proper amount of distention is ascertained by asking the patient to tell when he has a slight

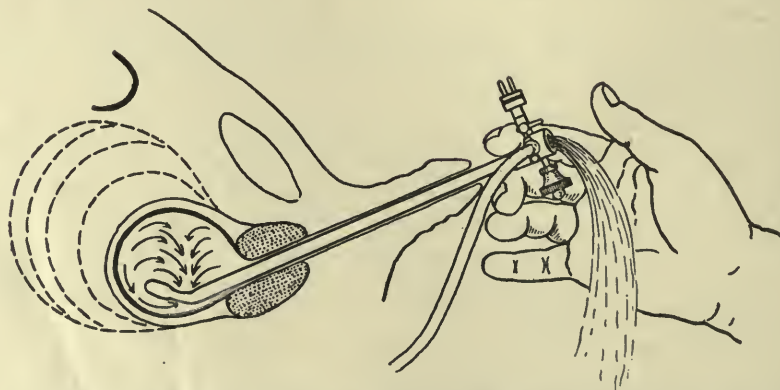


FIG. 14.—WASHING OUT BLADDER. The bladder having been distended with the solution, it is quickly flushed out by removing the thumb from the end of the sheath.

desire to urinate. The bladder should not be filled beyond this point. With the thumb held over the distal end of the tube to prevent the escape of the fluid, the telescope is quickly inserted into the sheath and firmly fixed by tightening the clutch. The irrigator is disconnected and the current turned on. Seating himself on a stool at the foot of the table, the surgeon begins the examination of the bladder.

Technic of Examination.—In examining the bladder the surgeon should adopt some routine method of manipulating the instrument so that every part of the viscus is brought into view and no area overlooked. There is a tendency on the part of begin-

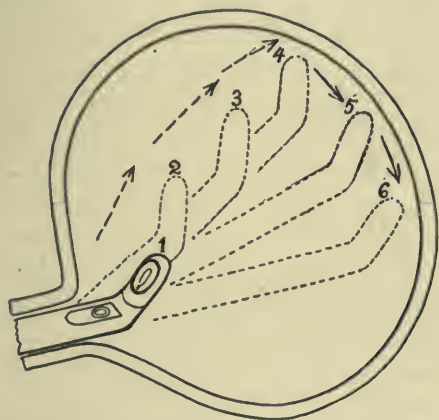


FIG. 15.—DIAGRAM SHOWING THE POSITIONS OF THE INDIRECT EXAMINING CYSTOSCOPE FOR INSPECTING THE UPPER AND LATERAL ZONES OF THE BLADDER.

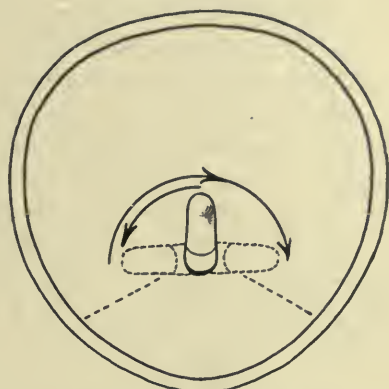


FIG. 16.—DIAGRAM SHOWING THE ARC OF ROTATION OF THE BEAK WHEN EXAMINING THE UPPER AND LATERAL ZONES OF THE BLADDER.

ners as soon as the cystoscope is introduced to make a hurried search for the ureters and immediately try to catheterize them. Although ureter catheterization is an important diagnostic measure, it should, as a rule, never be performed until the bladder has been carefully examined, as otherwise important data may be overlooked.

The examination should always be begun with the indirect telescope. After introducing the telescope into the sheath, the entire instrument is gently drawn outward until the beak, which points upward, is felt to impinge against the vesical neck. The surgeon, applying his eye to the telescope, slowly pushes the instrument into the bladder, at the same time rotating the sheath so that the beak describes an arc of 180° . As the instrument is thus advanced into the bladder, the ocular end should be gradually depressed. This elevates the distal end and, by bringing the lens and lamp nearer to the anterior wall and roof, gives better definition and illumination. As the posterior wall is approached, the ocular end is gradually lowered for the same reason. By this maneuver the anterior wall, roof and upper portions of the posterior and lateral walls are brought into view (Figs. 15 and 16).

There remain to be inspected the lower portions of the posterior and lateral walls, the fundus and trigone and also the paratrignon fossæ, which are shallow,

sloping depressions on either side of the trigone. The examination is continued as follows: When the cystoscope is in position (Figs. 15 and 16) rotate the sheath so that the beak turns directly downward. Slowly withdraw the sheath and rotate as before. The ocular end should be gradually elevated to bring the lens and lamp nearer to the bladder wall (Figs. 17 and 18).

The fundus and the lower portions of the lateral walls are first seen, after which the posterior boundary of the trigone, otherwise known as the interureteral band, appears. This latter is a guide to the ureteral openings. By following it to the right and left, the ureteral openings will successively appear. The

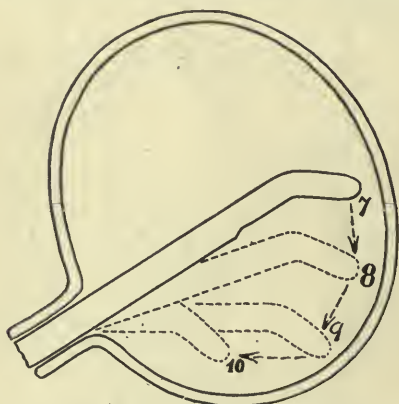


FIG. 17.—METHOD OF EXAMINING THE TRIGONE, VESICAL FUNDUS AND LATERAL WALLS.

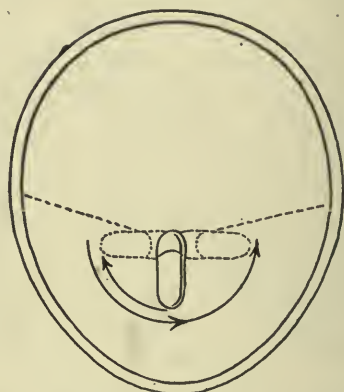


FIG. 18.—DIAGRAM SHOWING HOW THE BEAK IS ROTATED WHEN EXAMINING THE TRIGONE, FUNDUS AND LATERAL WALLS.

trigone, remainder of the lateral walls and paratrigoal fossæ are next examined.

The beak of the instrument is then turned upward and the current is turned off momentarily. The indirect telescope is withdrawn, leaving the sheath in situ, and replaced by the direct telescope. The instrument is then pushed well into the bladder to the posterior wall, and that part lying just above the fundus which is not clearly seen with the indirect telescope is examined. The instrument is then slowly drawn outward and, if desired, the fundus trigone and ureters may be examined by moving the ocular end from side to side.

The direct telescope is then withdrawn and, if the cystoscope is provided with a retrograde telescope, the latter is inserted in the sheath, and the neck of the bladder is viewed by rotating the sheath, making the beak describe a complete circle.

If the distending fluid becomes cloudy, due to pus or blood, or if fluid escapes during the interchange of telescopes, the bladder should be washed and refilled through the sheath as previously described.

Other methods of manipulating the cystoscope in order to examine the bladder are employed by some. For example, the method of Nitze is used: After

introduction of the instrument the beak is turned $22\frac{1}{2}^{\circ}$ to the left and advanced into the bladder in this position until the posterior wall is reached, after which it is rotated 45° to the right and drawn forward to the vesical neck, when it is rotated 45° more to the right and again pushed back into the bladder to the posterior wall, after which it is rotated to a corresponding position on the right side and again drawn forward. The beak is then turned downward and the fundus and trigone inspected in a similar manner.

This method necessitates constant pushing in and pulling out of the instrument, which is apt to cause pain. The method which I first described is simpler, requires fewer movements and is less painful.

To become a good cystoscopist requires much practice, patience and careful attention to detail. The surgeon should become familiar with his instrument before using it on a patient. It should be taken apart and the assemblage of the various portions fully understood. The lamps and electrical connections should be in working order before the examination. The telescope lens and eyepiece should be wiped dry with alcohol to insure a clear image. Nothing is more annoying than, having introduced an instrument with great care into the bladder of a nervous, apprehensive patient, to find that the lamp will not light, or that the image is indistinct because the lenses are obscured by some deposit. The various manipulations should be practiced on a phantom bladder, or, if that is not available, a hollow rubber ball about 3 in. in diameter serves equally well.

The appearance of the bladder and ureters in health and disease can be learned only by practical experience aided by the study of the many excellent colored illustrations in some of the larger special works on this subject.

The first few examinations are apt to prove very disappointing to the beginner. All that he will perhaps see at first is a small, circular, flat, illuminated image of pinkish hue with perhaps a few blood-vessels. Later on, with practice, as he becomes oriented, as it were, the examiner develops what Guiteras calls the "cystoscopic eye"; instead of seeing merely a flat illuminated surface, he begins to appreciate the various depths and elevations of the different parts of the bladder; the trigone differentiates itself from the rest of the viscus and the ureters are readily found. One is thus able to form a very definite mental picture of the interior of the organ.

Indications for Cystoscopy.—1. All cases in which the history, physical signs and symptoms point to disease of the bladder, ureters, and kidneys.

2. Hematuria and pyuria when urethral disease can be excluded.

3. To determine if the bladder is involved in extravesical conditions, such as uterine tumor, etc.

Contra-indications to Cystoscopy.—1. Acute inflammation of the bladder, prostate, seminal vesicles, urethra and epididymis.

2. In old people when the general condition is very poor or where there is urinary sepsis from advanced prostatic obstruction. In this last group, preliminary treatment and drainage should always precede cystoscopy.

Dangers of Cystoscopy.—If the cystoscope is forcibly introduced, traumatism of the urethra and bladder may be caused. Some lamps presumably cold if held against the bladder wall will cause a burn. Infection may result. If, however, the lamps are tested before use and sterilization carefully performed, and if gentleness is exercised in performing the various manipulations, these dangers can always be avoided.

Difficulties of Cystoscopy.—1. STRICTURE.—For a narrow meatus, a preliminary meatotomy should be done. Organic stricture should be dilated or cut. Spasmodic stricture usually yields to the instillation of a local anesthetic. In case it does not, a general anesthetic is necessary. Spasm of the cut-off muscle and its management have already been described (page 133).

2. ENLARGED PROSTATE.—An enlarged prostate may bleed freely and thus interfere with the examination. The bleeding often stops when equal parts of a local anesthetic and 1:1,000 adrenalin are instilled into the deep urethra. I recently saw a case of enlarged prostate and vesical calculi in which the bladder was so filled with stones that nothing was seen except a few calculi which lay in close contact to the lens.

3. SMALL INTOLERANT AND SENSITIVE BLADDERS.—These occur most frequently in tuberculosis and enlarged prostate. They may hold only 1 or 2 oz. of fluid. Often, as soon as the distending fluid is injected, a violent contraction of the bladder forcibly expels the solution, rendering examination impossible. Some of these bladders can be rendered more tolerant by daily irrigation with silver nitrate, 1:4,000, gradually increasing in strength and giving internally a mixture containing sodium benzoate, grs. xv, tincture belladonna, minims vii, and peppermint water 1 dram. This is taken 3 times a day between meals in a glass of water.

4. DISTENTION HEMATURIA.—This condition is sometimes encountered, notably in tuberculosis and prostatic hypertrophy, in which, if the bladder is filled beyond its capacity, hematuria results, discoloring the distending medium and interfering with examination. In these cases less solution should be used and it should be slowly injected. A general anesthetic will often allow the use of more solution without causing hematuria.

CATHETERIZING CYSTOSCOPES

There are 2 general types of catheterizing cystoscopes, those provided with an indirect catheterizing telescope and those having a direct telescope. The Brown-Buerger, Bierhoff and Wappler 1911 models are examples of the indirect variety, while the Guiteras cystoscope is a good example of the direct type. The composite instruments of Bransford-Lewis and Tilden Brown are provided with both direct and indirect catheterizing telescopes.

If an indirect instrument is used, the operation is termed ureter catheteriza-

tion by the *indirect* method, whereas if direct instruments are employed, it is termed *direct* catheterization.

In describing the technic of ureter catheterization, the Brown-Buerger instrument will be employed for the indirect method and the Guiteras cystoscope for the direct.

Brown-Buerger Catheterizing Cystoscope.—The Brown-Buerger indirect catheterizing cystoscope (Fig. 19) consists of (1) a sheath fenestrated and illuminated on the concavity which is used when the bladder can be fully distended;

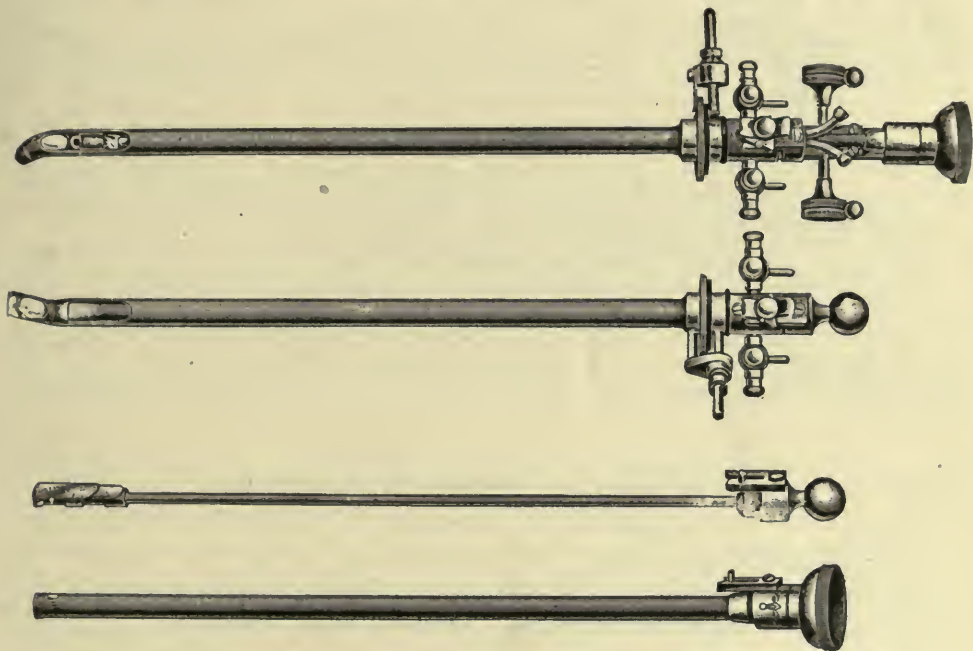


FIG. 19.—BROWN-BUERGER INDIRECT EXAMINING AND CATHETERIZING CYSTOSCOPE.

(2) another sheath fenestrated and illuminated on the convexity used for inspection and catheterization when the bladder is irritable and but little distention is possible; (3) an obturator which fits both sheaths; (4) an indirect examining telescope; (5) an indirect catheterizing telescope.

By means of the irrigating faucet on the sheath, the bladder can be washed and refilled at any time during the examination or catheterization without withdrawing the catheterizing apparatus.

Guiteras Catheterizing Cystoscope.—The Guiteras direct catheterizing cystoscope (Fig. 20) consists of an elbowed sheath having 2 faucets at its ocular end for irrigation, an indirect observation telescope which serves also as an obturator, a direct observation telescope, and a direct catheterizing telescope. With this instrument the bladder can be examined with the direct and indirect telescopes and the ureters catheterized by the direct method.

The catheterizing portion consists of a direct telescope (Fig. 20), on the

under surface of which are 2 grooves, each of which connects with a catheter outlet through which the catheters are inserted. The catheters pass through

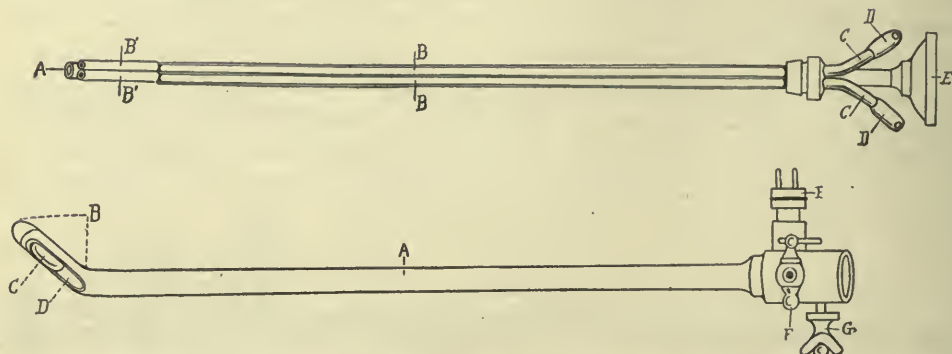


FIG. 20.—DIRECT CATHETERIZING TELESCOPE. In upper figure, A, lens window of telescope; B, grooves for catheters; each connects with the catheter channels C and terminates in a short tunnel B'; D, perforated rubber caps; E, eye piece of telescope.

In lower figure, A, shaft of cystoscopic sheath; B, beak; C, lamp; D, window for catheterizing telescope; E, electric coupling; F, faucet for washing and filling the bladder; G, clutch.

these grooves to the distal end of the instrument, from which point they are advanced into the ureters.

CATHETERIZATION OF THE URETERS

Before examining a patient, the surgeon should familiarize himself with the mechanism of the various parts of the instrument (Figs. 21 and 22).

Technic of Indirect Catheterization.—The patient having been properly prepared (see page 133), the cystoscope with its obturator is introduced. The

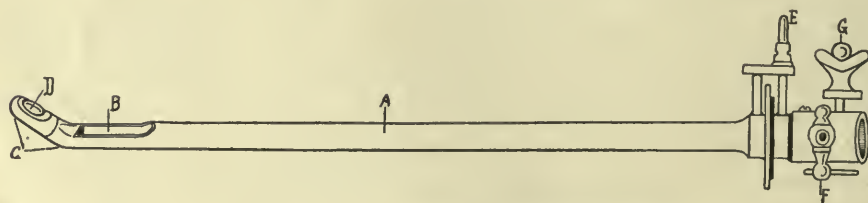


FIG. 21.—BROWN-BUERGER INDIRECT CATHETERIZING CYSTOSCOPE. A, Cystoscopic sheath; B, window or fenestrum; C, beak; D, lamp; E, electric coupling; F, faucet through which the bladder is washed and filled; G, clutch for securing catheterizing telescope in sheath for preventing escape of distending medium.

bladder having been filled, the indirect catheterizing telescope is passed into the sheath.

Before introducing the instrument, the ureter catheters should be introduced into the catheter outlets, which are capped with perforated rubber tips to pre-

vent leakage. Plugging the ends with a toothpick until the ureters are catheterized likewise assists in preventing the escape of the distending fluid. The catheters most suitable are the flute-end Albarran catheters No. 5 French. These catheters are graduated in centimeters, having a distinguishing mark at every 5 cm. (Fig. 23). This enables one to determine how far a catheter can be passed into a ureter and, if obstruction be present, its approximate location.

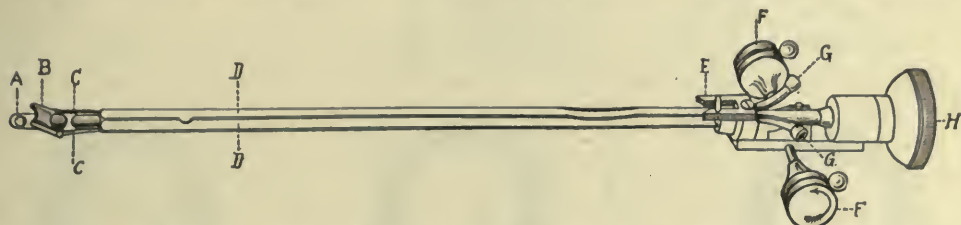


FIG. 22.—CATHETERIZING TELESCOPE OF THE BROWN-BUERGER CATHETERIZING CYSTOSCOPE. A, Lens window of telescope; B, Albarran deflector for guiding the catheters into the ureters; C, slender metal rods connecting the deflector with the screws F on the handle of the telescope; D, two parallel grooves on the under surface of the telescope for guiding the ureter catheters. They are continuous with the catheter channels G; E, clutch; H, eyepiece of telescope.

The surgeon should adopt some one method of distinguishing between the right and left catheter, otherwise, when the cystoscope is withdrawn, uncertainty may arise as to which is which, necessitating another examination or perhaps causing a grave error in diagnosis. Personally I always split the distal end of the **right** catheter for about $\frac{1}{4}$ in.

Various methods are described to aid one in quickly locating the ureters. All have their merits, but the surgeon will find them of but little help until he has become familiar with the appearance of the different parts of the bladder. Too often the beginner, instead of first familiarizing himself with the various landmarks of the bladder, immediately tries to locate the ureters, and failing, after a prolonged search, gives up very much discouraged.



FIG. 23.—FLUTE END URETER CATHETER OF ALBARRAN. It is graduated in centimeters up to 50 cm. There is a distinguishing mark at every 5 cm. Its caliber is 4 to 7 Charrière.

One method of locating the ureters is to turn the beak downward and push the instrument backward to the posterior wall. The ocular end is slightly elevated, bringing the lens nearer to the bladder wall. The cystoscope is then slowly drawn outward and at the same time rotated from side to side until one of the ureters appears or the interureteral band of Mercier is seen, when on rotation of the instrument to the right or left, the ureters appear in the field. The interureteral band sometimes appears as a distinct, rounded, elevated ridge stretching transversely across the cystoscopic image. Just as frequently, however, it is not seen at all. If the examiner bears in mind that the blood-vessels of the fundus are loosely meshed and quite distinct, while those of the trigone are much more closely woven and less distinct, and also that the color of

the trigone is more pink, he will more readily locate this landmark, as the transition in this region is quite abrupt. Following the "band" to the right or left leads to the ureters.

Another method is to pull the instrument forward to the vesical neck, turn the beak downward and slowly advance the cystoscope into the bladder, rotating it from side to side until the ureters appear or the "band" is recognized, in which case the ureters are located as previously described.

The examiner will soon realize, after examining a number of bladders, that ureteral openings differ very much in size, shape and appearance, and that it

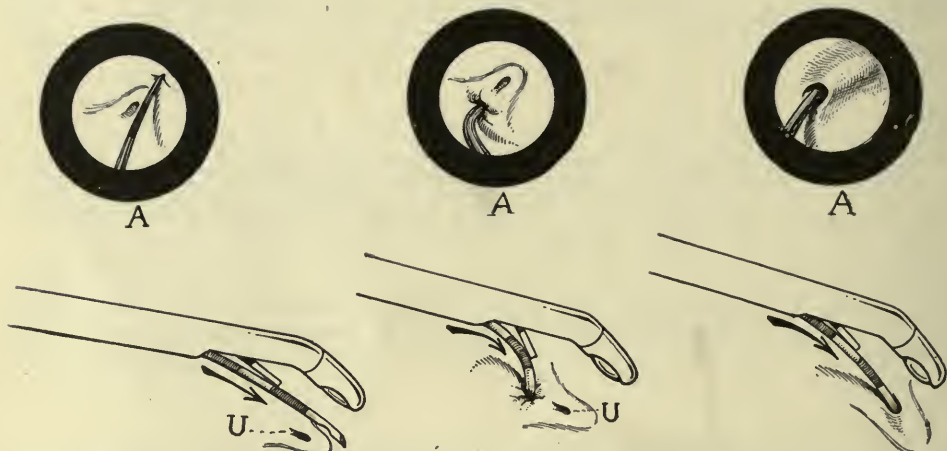


FIG. 24.—TECHNIC OF INDIRECT CATHETERIZATION. U, Ureter. The ureter catheter does not enter the ureteral orifice because it has not been deflected sufficiently. A, cystoscopic view.

FIG. 25.—TECHNIC OF INDIRECT CATHETERIZATION. In this case, the catheter gets caught in front of the ureteral orifice and bends on itself. This is caused by too much deflection.

FIG. 26.—TECHNIC OF INDIRECT CATHETERIZATION. Having secured the right angle of deflection, the catheter glides easily into the ureteral orifice.

is hard to find them because of the difficulty in recognizing them as such when they appear in the cystoscopic picture.

A normal ureteral orifice may appear as a pinkish slit on a low elevation or the margins may be more pronounced, appearing like an umbilicated round or oval elevation. In other cases the margins are thin and scarcely elevated, making it appear like an oval depression, or the posterior lip may be elevated, with the ureteral orifice lying just in front of it. Very often, especially in pathological conditions (congestion, edema and trabeculation), the ureters are so obscured that even an experienced cystoscopist fails to recognize them. In these cases they are located with the aid of the catheter as follows: As soon as the examiner sees something that looks like a ureteral orifice, he attempts to pass a catheter into it. If it does not engage or enter, the search is continued in this way until the ureter is found.

Having located the ureter, the next step is to bring the lens close to the ureter to facilitate catheterization. This is accomplished by elevating the ocular end

of the cystoscope and moving it at the same time toward the opposite thigh of the patient. The surgeon, holding the instrument steady with the left hand,

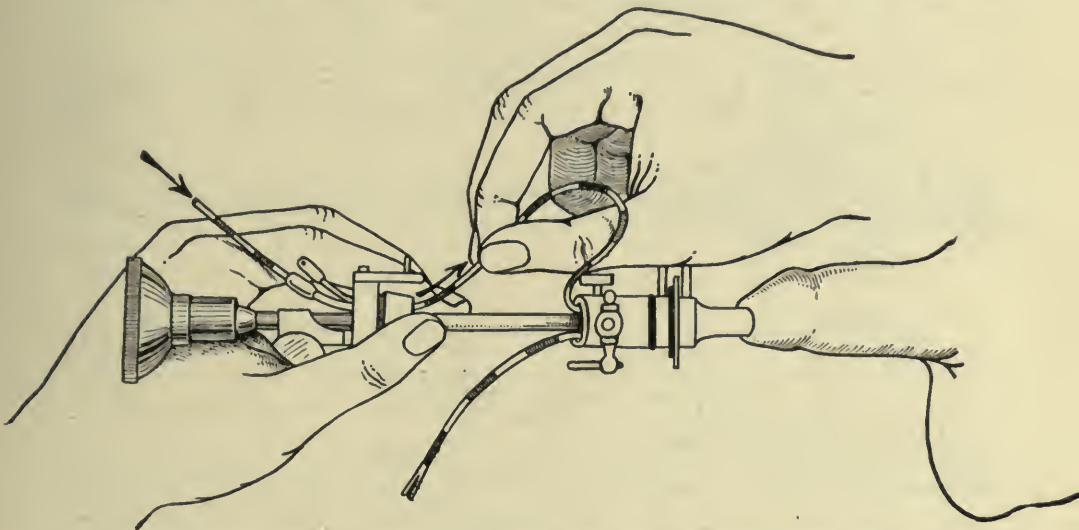


FIG. 27.—FIRST STEP IN REMOVING CYSTOSCOPE AND LEAVING CATHETERS IN SITU. The telescope is pulled out of the cystoscopic sheath for about one inch after which the catheters are freed from the telescope by pulling them through the catheter outlets from within outward, as indicated by the arrows. The end of the right catheter is split in order to identify it.

pushes the catheter through the cystoscope with the right until the end of the catheter appears in the upper part of the cystoscopic image. The catheter appears much larger because it lies very close to the lens. The catheter is then

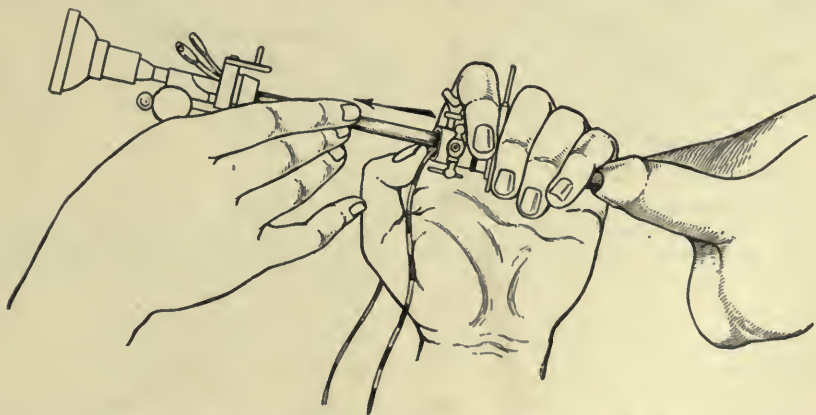


FIG. 28.—SECOND STEP IN REMOVING CYSTOSCOPE. Having freed the catheters from the telescope, the latter is drawn out of the cystoscopic sheath with the right hand. The catheters are prevented from being dislodged by holding them in place with the thumb of the left hand.

deflected downward toward the ureter by means of the Albarran lever, the movements of which are controlled by 2 screws on the ocular end of the telescope.

The catheter having been deflected, an attempt is made to enter the ureter by pushing the catheter forward. If it passes over and beyond the ureter (Fig. 24), more deflection is necessary; this is obtained by turning down the deflect-

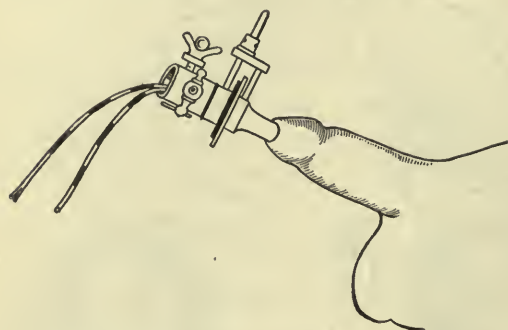


FIG. 29.—THIRD STEP IN REMOVING CYSTOSCOPE. Having removed the telescope, the catheters are pushed into the sheath for about 4 in. to insure against dislodging the catheters when the sheath is removed.

ing lever to a greater degree. If the tip of the catheter seems to get caught just in front of the ureteral orifice, and does not advance but turns on itself (Fig. 25), this is due to too much deflection, which is remedied by elevating the deflecting lever.

With a little practice, the proper amount of deflection is soon learned and the catheter will easily slip into the ureter (Fig. 26). Having entered the ureteral opening, the catheter is slowly pushed up into the ureter. At the same time the distance is noted, being read in centimeters at the ureteral meatus. For catheterizing purposes, about 12 cm. of catheter should be passed into each ureter. The catheter should be pushed in gently and slowly, never rapidly and forcibly, as traumatic hemorrhage results, often interfering with the object of the examination.

Traumatic hemorrhage due to the catheter rarely appears immediately; but usually after 10 or 15 minutes it suddenly shows itself, giving a bright red color to the upper part of the urine, in contrast to the uniform smoky red color seen in true renal hematuria. Traumatic hemorrhage is apt to stop rather suddenly; renal hemorrhage is more constant and uniform. Except in cases of advanced hypernephroma or malignant disease or in rupture of the kidney, the urine is never bright red. It is important to bear these differences in mind, as otherwise the results will be confusing and may lead to errors in diagnosis.

Having catheterized one ureter, the sheath is rotated toward the opposite side and the remaining ureter is catheterized in the same way. If the fluid becomes cloudy, the bladder is washed and filled through the faucets without removing the telescope. Having catheterized both sides, the next step is to remove the telescope and sheath, leaving the catheters in situ.

The current is turned off and both faucets are opened, emptying the

ing lever to a greater degree. If the tip of the catheter seems to get caught just in front of the ureteral orifice, and does not advance but turns on itself (Fig. 25), this is due to too much deflection, which is remedied by elevating the deflecting lever.

With a little practice, the proper amount of deflection is soon learned and the catheter will easily slip into the ureter (Fig. 26). Having entered the ureteral opening, the catheter is slowly pushed up into the ureter. At the same



FIG. 30.—CYSTOSCOPE REMOVED LEAVING THE CATHETERS IN POSITION. Each catheter is placed in a small sterile bottle labeled "Right" and "Left."

bladder, and the plugs are removed from the ends of the catheters. Steadying the sheath with the left hand, the telescope is withdrawn for about an inch, and the proximal end of each catheter is drawn through the catheter outlets (Fig. 27). Before withdrawing the telescope, make sure that the deflecting lever is turned up and lies parallel to the telescope; otherwise it may be damaged or interfere with the withdrawal of the telescope. Having freed the proximal ends

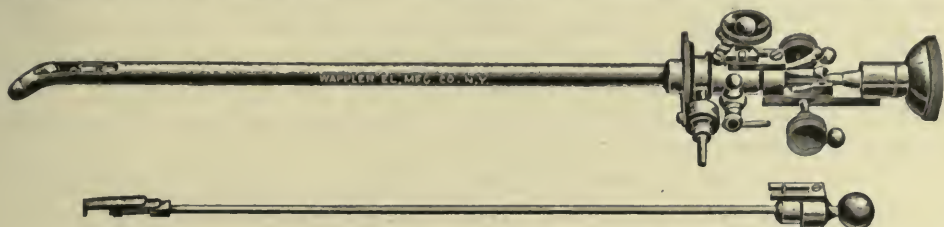
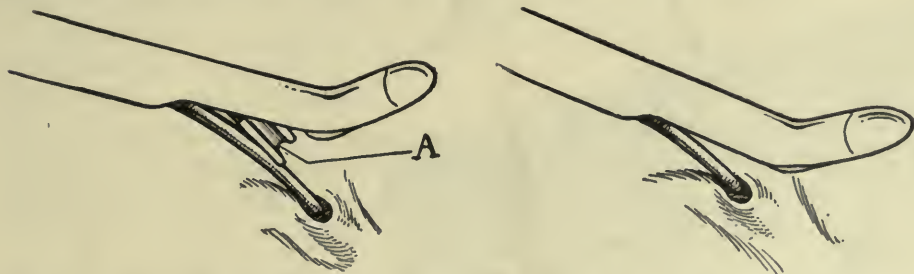


FIG. 31.—WAPPLER 1911 CATHETERIZING CYSTOSCOPE. This instrument is 24 Charrière in caliber and can be used with two No. 6 catheters.

of the catheters, the telescope is withdrawn from the sheath (Fig. 28), after which 4 or 5 in. of the projecting ends of the catheters are pushed into the bladder through the sheath to insure against pulling the catheters out of the ureters when the sheath is withdrawn (Fig. 29). The sheath is then rotated so that the beak is turned upward and slowly withdrawn. As the beak is felt to pass the cut-off muscle, make firm pressure just below it on the perineum, thus preventing the ureteral catheters from becoming dislodged.



FIGS. 32 AND 33.—URETERS ARE LOOKED FOR IN THE SAME WAY AS DESCRIBED WITH BROWN-BUEGER CYSTOSCOPE. The catheter is deflected toward the ureter with the Albarran lever. Having entered the ureter, the deflector is no longer needed as the catheter easily advances up into the ureter as in the direct method.

The cystoscope having been removed with the catheters in situ, the next step is to make the patient as comfortable as possible while specimens of urine are obtained or functional tests are performed. The foot of the table is raised and the patient's legs are removed from the stirrups and allowed to rest upon it. The head of the table should be raised to an angle of about 45°. A still better way is to have the patient get off the table and lie on a couch in a semireclining position. The ends of the catheters are then placed in flasks labeled "right" and "left" (Fig. 30). If it is desired to make a culture, a few drops are allowed to flow onto suitable culture media.

The technic just described applies to practically all indirect catheterizing cystoscopes with the exception of the Wappler 1911 catheterizing instrument (Fig. 31). After introducing the sheath of this instrument and filling the

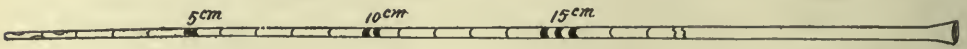


FIG. 34.—GARCEAU URETERAL CATHETER. This catheter is useful to prevent leakage in cases where only one ureter can be catheterized and in performing quantitative functional tests. It gradually increases in caliber from No. 4 at its tip to No. 11 at fifteen centimeters. Its length is seventy centimeters. It can be employed only with an operating cystoscope having one large catheter channel.

bladder, the telescope is introduced in the same way. The beak of the sheath should not be turned down, because the lens and catheterizing portion already look down. The ureters are looked for in the same way. Having located a ureter, bring the lens close to it. The catheter is then deflected at the proper angle by the Albarran lever and advanced into the ureter (Fig. 32), after which there is no further use of the deflecting lever, which is turned upward to

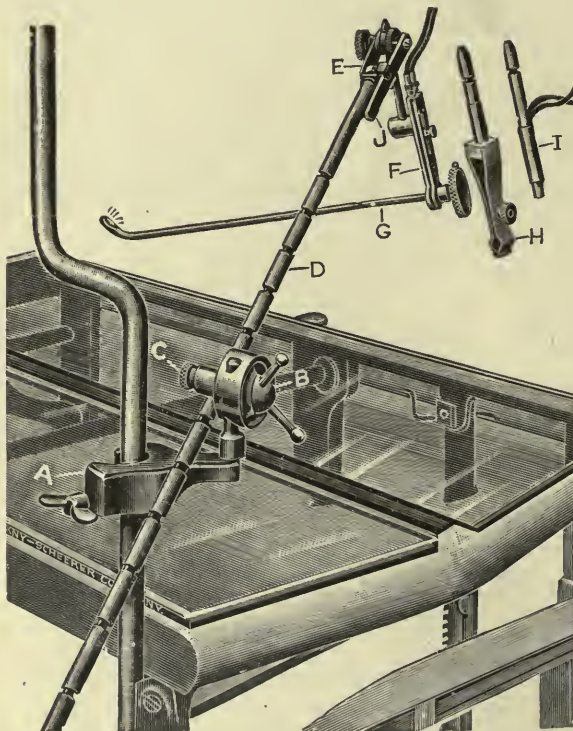


FIG. 35.—FURNISS CYSTOSCOPIC HOLDER. This holder can be attached to the upright of any table stirrup.

its original position. The catheter is then pushed up into the ureter in exactly the same manner as in the direct catheterizing cystoscope (Fig. 33).

If only one ureter can be located, catheterize it, after which inject indigo-carmin as described under Functional Tests (Chap. VI) and watch through the cystoscope for the appearance of the dye from the uncatheterized side.

If it is impossible to catheterize one side, either on account of obstruction due to stone or stricture or because of inability to locate the orifice, the separate urines may be obtained by catheterizing the one side with the largest sized catheter which the cystoscope will admit and with-

drawing the instrument leaving the catheter in position. Next pass a woven or soft rubber urethral catheter into the bladder and thoroughly empty it. The urine coming from the urethral catheter will be that of the side which could not be catheterized, while that draining from the ureter catheter is from the cathe-

terized kidney. To determine if leakage takes place along the ureter catheter into the bladder, inject a little colored solution, such as methylene blue, into the ureter catheter. If leakage occurs some of the dye will appear in the urine draining from the urethral catheter. A still better way to prevent leakage in these cases is to use a Brown-Buerger operating cystoscope which is provided with a single large catheter outlet through which a tapering Garceau catheter, size 11 French (Fig. 34), is passed up one ureter, insuring a tight fit and thus preventing contamination of the urine draining through the urethral catheter.

If for some reason, due perhaps to obstruction low down in the ureter, the catheter enters only an inch or two, the cystoscope must be left in the bladder during the examination. Furniss has devised a very convenient holder which retains the cystoscope in position (Fig. 35).

The Wappler 1911 catheterizing cystoscope (Fig. 31), which is a modified Freudenberg instrument, differs from other indirect cystoscopes in that the tele-

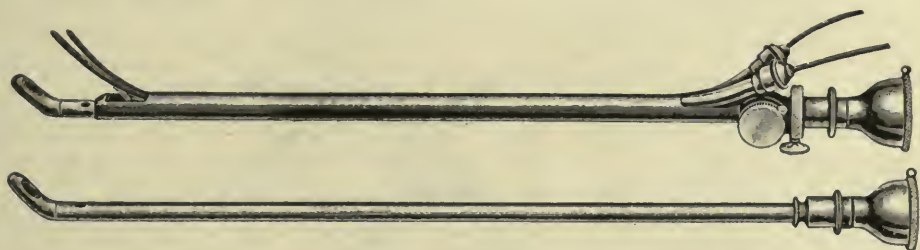


FIG. 36.—BIERHOFF'S INDIRECT CATHETERIZING CYSTOSCOPE. The telescope can be removed from the catheterizing portion and used as a plain observation instrument. Having catheterized the ureters the beak can be rotated, thereby overcoming the consequent twisting of the catheters if they are to be left in situ.

scope is provided with an oblique view optical system. Its sheath is fenestrated and illuminated from the convexity. This allows the lens to be brought very close to the ureteral orifice. The oblique view optical system, which projects the line of vision slightly forward, in conjunction with the catheterizing mechanism on the convexity of the beak, makes it practically a direct catheterizing cystoscope, with the additional advantage of an indirect telescope for easily locating the ureters.

The Bierhoff double catheterizing and irrigating cystoscope (Fig. 36) differs from the others in that the catheterizing portion is part of the sheath instead of being attached to the telescope. Moreover, the sheath can be readily removed, leaving a plain indirect observation cystoscope. This is accomplished by unscrewing the beak, which in this instrument is attached to the telescope instead of the sheath, thus allowing its easy withdrawal from the catheterizing portion. The beak which contains the lamp is then screwed on the telescope, which can be used as a non-irrigating indirect cystoscope similar to the older Nitze instrument.

After the ureters are catheterized, the beak can be turned upward by simply rotating the telescope within the sheath. This obviates turning the entire instru-

ment in order to withdraw it from the bladder, thereby preventing twisting of the catheters.

Technic of Direct Catheterization.—1. Prepare patient for cystoscopy (page 133).

2. Test cystoscopic lamp and place ureteral catheters in the catheter outlets, which should be capped with perforated rubber tips to prevent leakage.

3. Introduce sheath with obturator.

4. Remove obturator.

5. Wash and fill bladder through the sheath.

6. Insert catheterizing telescope into sheath.

7. Do not turn beak downward.

8. Turn on current.

The ureters are looked for in the same way as in indirect catheterization, but will be found with much greater difficulty. Instead of rotating the sheath,

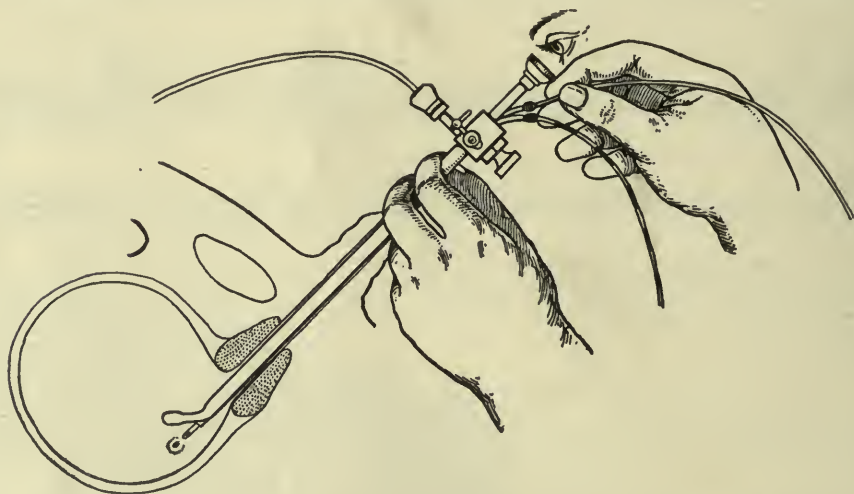


FIG. 37.—DIRECT CATHETERIZATION OF URETERS SHOWING POSITION OF HANDS.

move it from side to side, being careful that the beak always looks vertically upward. Having located a ureter, catheterization is very simple. The lens is brought close to the ureteral opening, after which the catheter is slowly pushed through the sheath into the bladder, through the ureteral orifice, and slowly advanced up into the ureter (Fig. 37). Having catheterized one side, the other ureter is looked for in the same way and similarly catheterized. The sheath and telescope are withdrawn in precisely the same way as described under indirect catheterization.

Comparison of the Two Methods.—In Europe, catheterization of ureters by the indirect method is the method of choice. Up to a few years ago, the direct method enjoyed most favor in America. Of late, however, there is a growing tendency on the part of American urologists toward the indirect method.

Formerly, indirect catheterization was a very difficult procedure, because the instruments were not so well constructed as they are today. The images were all inverted and, although the ureters were easily found, it required a great deal of technical skill to insert the catheters into the ureters when viewing the latter upside down. Furthermore it was claimed that on account of the deflection necessary in the indirect method the catheter had to be bent in 2 places in order to insert it into the ureter, i. e., it was first bent downward (Fig. 38, A) by the deflector and was again bent at the ureteral orifice (Fig. 38, B) in an upward direction. This double bending made it difficult to advance the catheter up into the ureter.

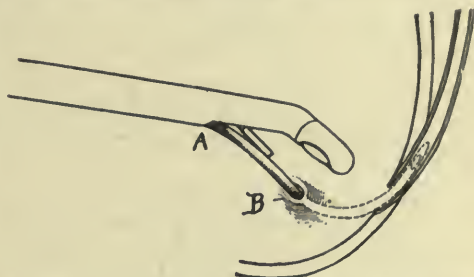


FIG. 38.—COURSE TAKEN BY URETER CATHETER IN INDIRECT CATHETERIZATION.

In the present day instruments, these difficulties have practically all been eliminated. The double bend which the catheter must take while it is being advanced into the ureter has been entirely eliminated when the lens and deflecting apparatus are on the convexity of the beak, as in the 1911 instrument of Wappler, the deflector being merely used to guide the catheter into the ureter, after which it is turned upward and the catheter advanced as in the direct method. An instrument of this type has

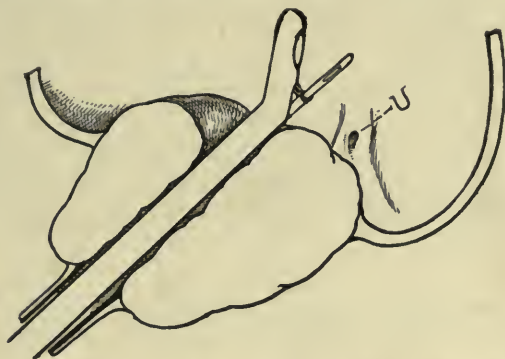


FIG. 39.—SHOWING HOW AN ENLARGED PROSTATE MAY PREVENT THE CATHETERIZATION OF THE URETER BY THE DIRECT METHOD.

the combined advantages of the indirect telescope for locating the ureters and of the direct method for catheterization.

Personally, I always use the indirect method and recommend it in preference to the direct, because the ease with which the ureters are found more than compensates for the little practice necessary in the beginning to guide the catheter

into the ureter. Furthermore, there are certain cases, notably in prostatic hypertrophy, in which the trigone is elevated, making it sometimes very difficult to find the ureters with the direct telescope. In these cases, even when they are found, it is often impossible to catheterize them, on account of the intervening intravesical projection of the enlarged prostate (Fig. 39).

INTRAVESICAL CYSTOSCOPIC PROCEDURES FOR DIAGNOSIS AND TREATMENT

Diagnosis and Location of Calculus Obstructing the Ureter.—A calculus caught at some part of the ureter may sometimes be detected by the wax-tipped ureteral catheter. About $\frac{1}{2}$ in. of the end of a ureteral catheter is dipped into melted wax, so that it receives a thin coating. A catheterizing cystoscope, either of the direct or indirect variety, is used. If the latter is used, a sheath having the

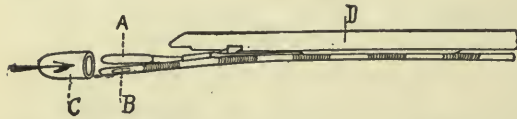


FIG. 40.—METHOD OF LOCATING AND DETERMINING THE NATURE OF AN URETERAL OBSTRUCTION. A, Waxed-tip catheter; B, unwaxed catheter; C, small gelatin capsule filled with lubricating jelly which is placed over the ends of both catheters; D, telescope.

fenestrum on the convexity is preferable. It is important to protect the waxed end of the catheter from being scratched by the cystoscope. Various methods have been devised. The following method has proven satisfactory. The catheterizing telescope is first prepared as follows: If calculus is

suspected in the right ureter, an unwaxed ureteral catheter is passed through the left catheter outlet of the telescope until its end projects about $\frac{1}{2}$ in. beyond the lens. The waxed-tip catheter is then passed through the right catheter outlet from within outward, far enough so that its waxed end will also project about $\frac{1}{2}$ in. beyond the end of the telescope. One-half of a small gelatin capsule is filled with some lubricating jelly and placed over the ends of both catheters (Fig. 40).

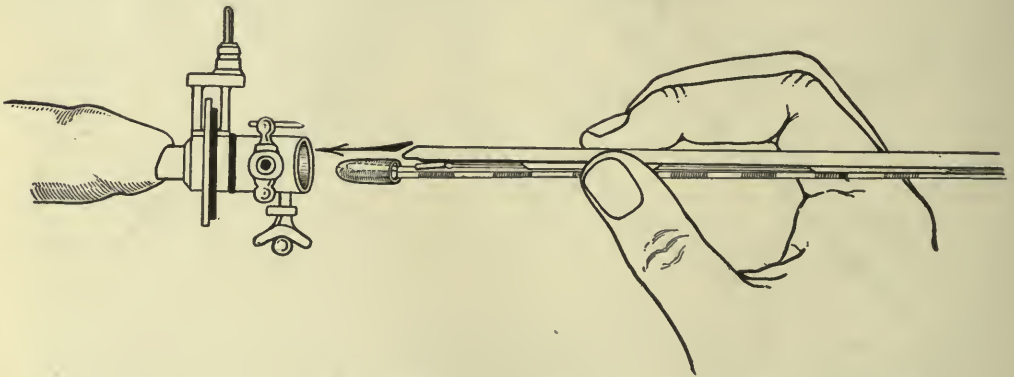


FIG. 41.—SHOWING HOW THE CATHETERIZING TELESCOPE AND CATHETERS COVERED WITH A GELATIN CAPSULE ARE PASSED INTO THE SHEATH OF THE CYSTOSCOPE.

The cystoscopic sheath and obturator having been introduced into the bladder, the latter is withdrawn and the telescope with the ends of the catheters incased in the capsule is passed through the sheath of the cystoscope (Fig. 41). The capsule should be placed well in advance of the end of the telescope, otherwise it will prevent its introduction.

Having inserted the telescope, the unwaxed catheter is then advanced into the bladder, carrying with it the capsule, which drops off, leaving the waxed

catheter end uncovered (Fig. 42). The capsule dissolves in a few moments. The waxed catheter is then passed into the ureter as far as it will go. The distance it enters the ureter should be noted by counting the number of centimeters which pass through the ureteral orifice.

The sheath and telescope are removed, leaving the waxed catheter in the ureter, after which the latter is slowly and gently withdrawn. The waxed end should then be examined through a magnifying glass. If stone is present, scratch marks will be seen. If the catheter has passed the stone, the scratch marks will be seen on the sides of the catheter, whereas if it has not passed, its end will be irregularly flattened or dented and covered with scratch marks.

Cystoscopic Lithotrity and Litholapaxy.—

The cystoscopic attachment to the lithotrite enables the surgeon to see what he is doing. He can see that the stone and not the bladder wall is grasped by the jaws of the instrument, and can also determine whether any large fragments remain and crush them all at a single sitting.

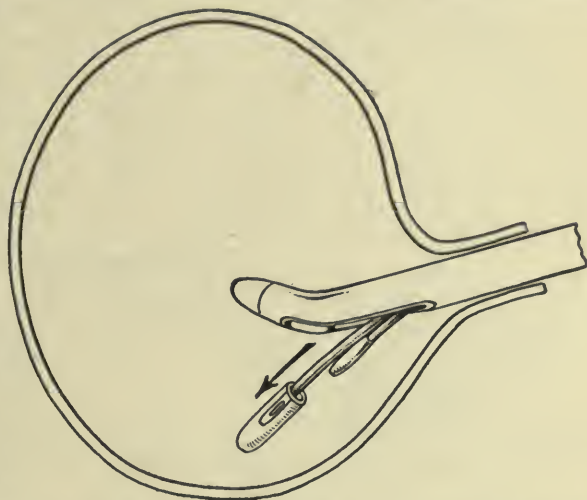


FIG. 42.—INTRODUCTION OF WAXED-TIP CATHETER INTO BLADDER. Having introduced telescope with catheter ends covered with capsule, unwaxed catheter is advanced into bladder thus removing capsule from waxed end of other catheter. Unwaxed catheter is drawn back into sheath of cystoscope and waxed catheter is inserted into suspected ureter.



FIG. 43.—CYSTOSCOPIC LITHOTRITE. A, Shaft; B, female blade; C, male blade; D, telescope; E, lamp; F, lens window of telescope; G, handle; H, wheel which when rotated opens and closes jaws of lithotrite; J, ocular end of telescope; K, small knob which indicates the position of the telescope lens.

The instrument closely resembles the ordinary lithotrite except that the shaft is hollow to allow the passage of an indirect telescope through it. A lamp is placed in the distal end of the telescope (Fig. 43).

TECHNIC.—The patient is prepared as for cystoscopy. The bladder is washed and filled through a soft rubber or woven catheter. The bladder should be distended as fully as is consistent with the comfort of the patient.

1. Introduce the telescope into the lithotrite far enough for its rounded end to act as an obturator. The jaws should be closed.

2. Introduce the lithotrite into the bladder, beak up, using the same technic as in passing a metallic sound. (Fig. 44.)

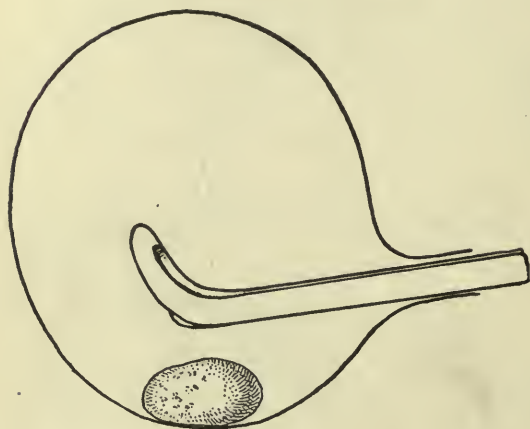


FIG. 44.—CYSTOSCOPIC LITHOTRITY. Introduction of the instrument.

3. Push the telescope into the sheath as far as it will go. The lens should look upward toward the beak. The position of the lens is determined by the little knob on the ocular end of the telescope (Fig. 45).

4. Rotate the instrument so that the beak and lens look downward (Fig. 46).

5. Turn on the light and inspect the bladder for position and number of calculi.

6. Having located the calculus, the blades are opened by turning the screw on the handle of the lithotrite. The amount of separation of the blades corresponds to the amount of screw exposed.

7. The telescope is then pulled toward the operator until the lens lies midway between the blades, i. e., when both blades are seen in the cystoscopic image (Fig. 47).

8. The blades are then closed on the stone (Fig. 48).

9. The telescope is then rotated so that the lens is turned away from the stone to prevent injury to the prism while the stone is being crushed.

10. The lithotrite is then turned beak upward, and the stone crushed (Fig. 49), after which the lens is again turned so that it lies between the blades. The beak is again turned downward and the bladder is examined to see if any more stones are present or if any of the remaining fragments are too large to be washed out, in which case each is crushed as described.

11. Having crushed all the calculi, the telescope is withdrawn and the



FIG. 45.—ADVANCING THE TELESCOPE THROUGH THE SHEATH OF THE LITHOTRITE INTO THE BLADDER.

bladder is washed out through the lithotrite until all the fragments are removed. This is determined by inserting the telescope and examining the bladder.

Hard stones can be crushed with this instrument, which is capable of exerting a pressure of 175 pounds.

When the bladder is tolerant and the calculus is small or of moderate size, the cystoscopic lithotrite is an excellent instrument for crushing the stone. In the case of contracted irritable bladder, accompanied by intense cystitis, as shown by urgency and frequency of urination, purulent urine and hematuria, the telescopic attachment is of no value because the distending medium becomes cloudy very quickly due to pus and blood thereby obscuring the image. In these cases, give a general anesthetic and employ the Thompson or Bigelow lithotrite. If the stone is large perform suprapubic lithotomy. Never perform lithotripsy until the exact size of the stone has been previously determined by radiographic examination.

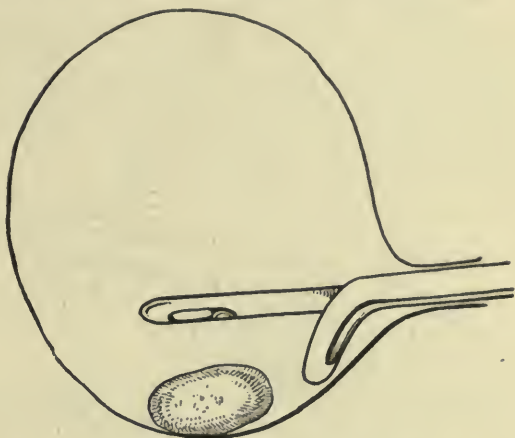


FIG. 46.—LITHOTRITE ROTATED SO THAT THE BEAK AND TELESCOPE LOOK DOWNWARD, AFTER WHICH THE POSITION OF THE CALCULUS IS DETERMINED.

Cystoscopic Treatment of Benign Bladder Tumors with the Oudin High-frequency Current: Fulguration.

—This method of treating benign neoplasms of the bladder, first used by Beer, is commonly but erroneously known as “fulguration.” This term was first applied to the de Keating-Hart-Pozzi method of treating malignant growths and consists of operative removal of the tumor followed by long and powerful sparkings of great frequency and high tension applied to the wound. In the Beer method “the high-frequency current of Oudin is

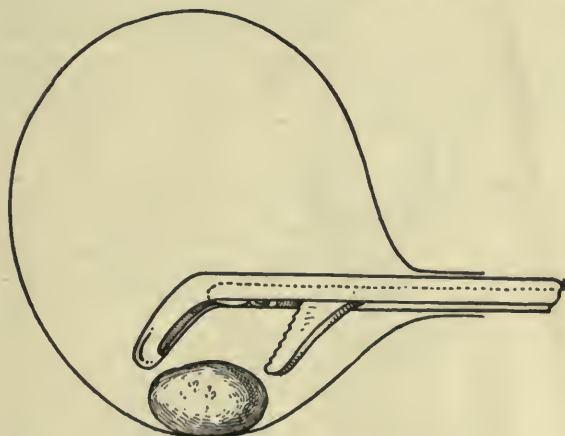


FIG. 47.—OPENING THE BLADES OF THE LITHOTRITE.

applied through a copper (heavily insulated) electrode under water to a benign growth, no spark being seen if the application is properly made.”

TECHNIC.—The necessary equipment consists of (1) a high-frequency ma-

chine with the Oudin resonator, (2) an operating or a catheterizing cystoscope, direct or indirect, (3) a heavily insulated copper electrode No. 6 Charrière. The end of the wire electrode should be cut off before the application.

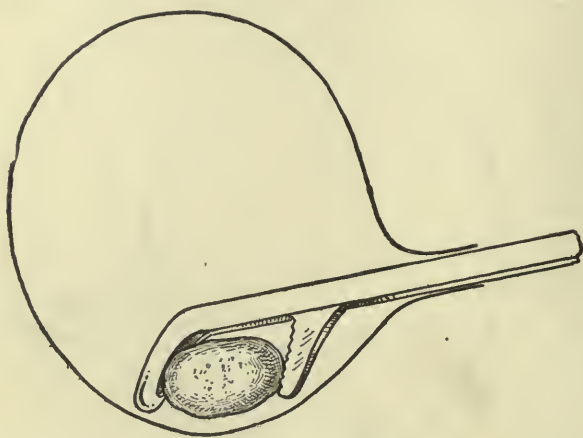


FIG. 48.—GRASPING THE CALCULUS.

The patient is prepared for cystoscopy. The cystoscopic sheath and obturator having been introduced, the bladder is washed and filled with distilled water, after which the direct or indirect catheterizing telescope is inserted into the sheath. One catheter outlet is capped with a closed rubber tip to prevent leakage. Through the other outlet is passed the electrode, which is simply copper wire heavily insulated. The distal

end of the wire is connected with the high-frequency machine. The spark gap in the muffler should be about $1/10$ in. and never more than $1/8$ in.

The tumor having been located, the application is made as follows: The electrode is advanced through the cystoscope into the bladder directly in among the villi of the growth (Fig. 50). The high-frequency current is then turned on for from 10 to 30 seconds. Similar applications are made to different parts of the tumor. This is continued until the entire surface of the tumor has been treated. Unless the tumor is very large, single applications lasting 10 to 15 seconds are sufficient. A total of 3 to 5 minutes at one sitting usually suffices. A few days later it should be repeated if any viable tumor tissue is seen. Treatments are discontinued as soon as the entire growth appears necrotic.



FIG. 49.—BEAK OF LITHOTRITE. AFTER HAVING GRASPED CALCULUS ROTATED UPWARD. This insures against injuring the bladder, the lens of the telescope is turned away from the calculus, after which the blades are closed, crushing the calculus.

AFTER-TREATMENT.—The patient is given a suppository containing quinin sulphate, gr. x, and morphin sulphate, gr. $1/4$, and the bladder irrigated with 1:4,000 silver nitrate solution. The sloughs are allowed to separate spon-

taneously or are helped along by bladder irrigations of silver nitrate 1:4,000. After the base of the tumor is exposed, it should be treated as were the original outgrowths until it completely disappears. The patient should be cystoscoped from time to time, and if suspicious areas are seen they should be destroyed at one sitting.

IMMEDIATE EFFECTS.—No spark is seen if the electrode is properly placed among the villi. When the current is on, gas is freely generated and is seen bubbling out of the growth. If the point of application is superficial, one can see the blanching of the tissues where the current is applied. At the spot where

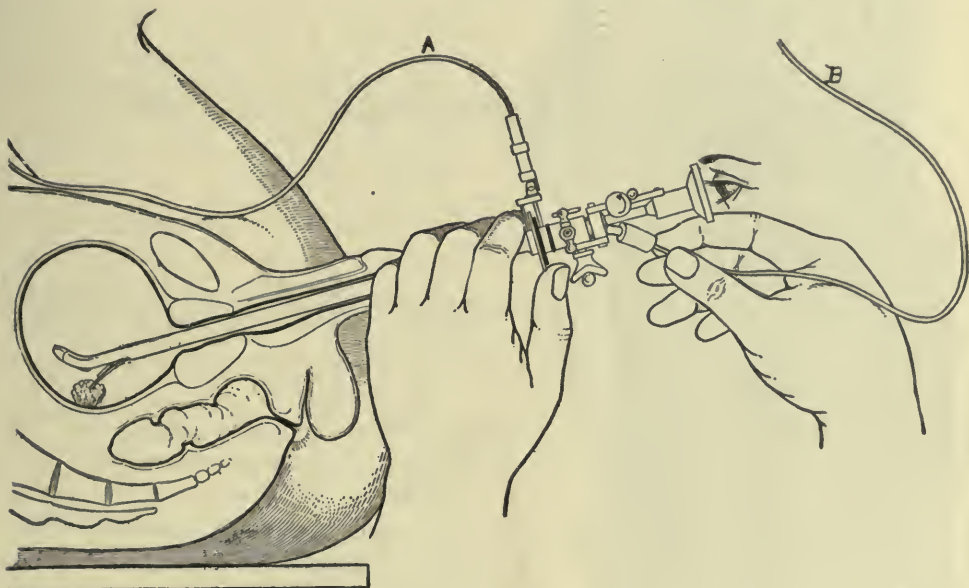


FIG. 50.—APPLICATION OF HIGH FREQUENCY CURRENT FOR DESTRUCTION OF BENIGN NEOPLASMS OF BLADDER. A, Conducting cable for illumination; B, wire electrode connected with high frequency machine.

the electrode rested the tissues are blackened. As the electrode is withdrawn from the growth very frequently it adheres to the villi and may come away with some of the tumor tissue baked to its tip. This is sometimes followed by bleeding, but a re-application of the current to the same spot usually controls this. A day or 2 later the growth has a grayish-black, necrotic appearance.

Sometimes secondary hemorrhage occurs when the sloughs separate. This usually appears on the third or fourth day after the current has been applied. It is usually moderate in character, giving the urine a pink color and lasting only a few days. In two of my cases it was quite severe; the urine became dark red and contained clots. There was also frequency of urination and vesical tenesmus. In both instances I succeeded in checking the hemorrhage by the daily injection of one ounce of 1:3,000 adrenalin solution into the bladder for three days after which the bladder was irrigated every day with

1 : 4,000 silver nitrate. Internally, calcium lactate gr. xv was given three times a day. When secondary hemorrhage occurs, do not reapply the current until the urine has been free from blood for at least one week.

DANGERS OF THE TREATMENT.—If the electrode touches the bladder wall, severe burning or perforation may result. When the electrode touches the bladder, the patient feels a distinct burning sensation. This should warn the surgeon. Sparking of the tumor never causes pain. If one places the electrode properly before turning on the current and does not apply it for too long a time, this should never happen. In one of our cases, a man aged 60, stout and plethoric, in whom we treated 2 papillomata near the left ureter, there developed symptoms of pulmonary embolism. These cleared up in 48 hours and he made an uninterrupted recovery.

RESULTS.—In 200 cases collected by Beer definite cures with no recurrence after 2 years are reported. The majority of these were carefully controlled by repeated cystoscopic examinations.

SELECTION OF CASES.—No malignant growth will be cured by this method. Early operation can alone cure these cases. A specimen of the tumor should always be obtained for microscopic study and its nature determined before treatment.

This treatment is contra-indicated in all papillary carcinomata. Patients intolerant of cystoscopic examination cannot be treated by the urethral route. It is likewise contra-indicated in those cases in which the

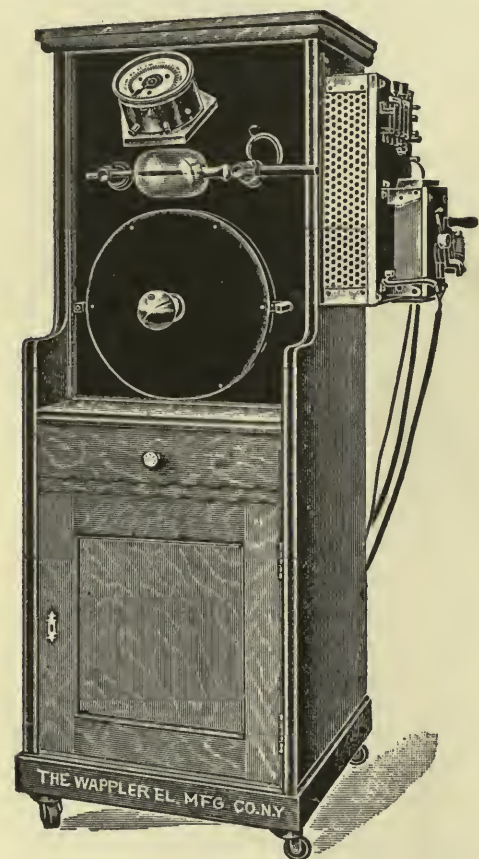


FIG. 51.—HIGH FREQUENCY MACHINE GIVING OUDIN AND D'ARSONVAL CURRENTS.

growths are inaccessible to the cystoscope. These are usually large tumors near the neck of the bladder which bleed severely when the cystoscope is introduced, preventing accurate work.

D'ARSONVAL BIPOLAR HIGH-FREQUENCY SPARK.—To obtain deeper penetration of the spark in treating large tumors, the D'Arsonval bipolar high-frequency spark is used. The technic is exactly the same except that, as the current is bipolar, 1 large electrode is placed on the patient's abdomen. The action of the current is harsher than the Oudin and should be used with caution.

In order to measure the exact penetration of the spark, a piece of raw

meat is first subjected to the current and its strength so regulated that the depth of penetration will be about $\frac{1}{4}$ in.

Both the Ondin and the D'Arsonval currents can be obtained from the Wappler high-frequency machine (Fig. 51).

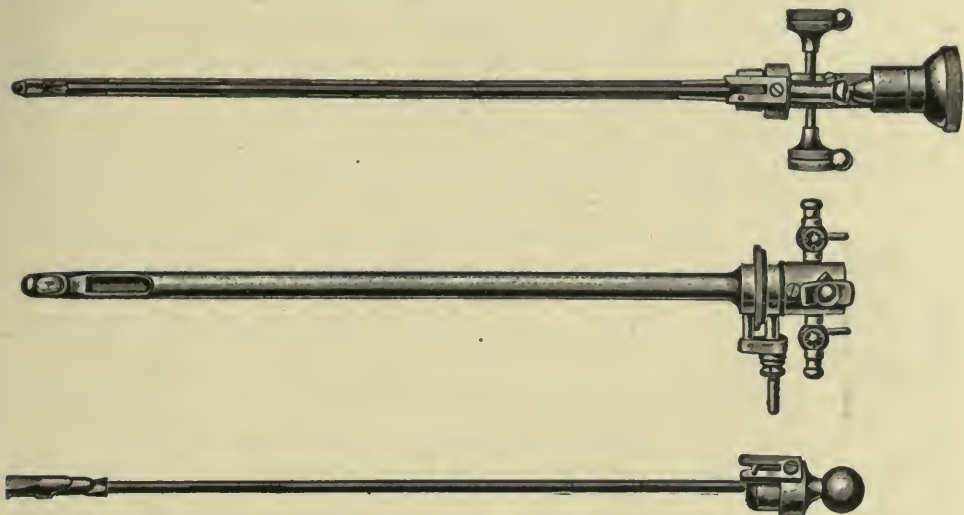


FIG. 52.—BUERGER INDIRECT OPERATING CYSTOSCOPE.

The following intravesical cystoscopic procedures will be found useful for the diagnosis and treatment of certain bladder and ureteral conditions. These include:

1. Removal of small stones and foreign bodies.
2. Obtaining specimens of pathological tissue for microscopic study.
3. Snaring of polypi and papillomata.
4. Synchronous catheterization of three ureters.
5. Dilatation of the ureteral orifices.

Instruments Required.—1. Operating cystoscope.

2. Punch forceps.
3. Snare.
4. Scissors.
5. Knife.
6. Olivary electrodes.
7. High-frequency machine.

OPERATING CYSTOSCOPES.—The indirect operating cystoscope is more useful than the direct because a greater portion of the bladder can be more easily reached with it. The manipulations are perhaps a little more difficult, but with a little practice they are soon learned. The instruments are all flexible and are all guided to the lesion in precisely the same way that a ureteral catheter is guided to the ureteral orifice.

The Buerger operating cystoscope (Fig. 52) is an excellent instrument of the

indirect variety for performing the above-mentioned manipulations. It is very similar in construction to Buerger's catheterizing cystoscope except that the 2 sheaths, one of which is fenestrated on the convex and the other on the concavity, are slightly oval instead of cylindrical. This allows more room for the instruments. Instead of 2 catheter outlets, it has 1 large channel admitting the cystoscopic instruments and a No. 11 Gareeau catheter designed for quantitative and functional tests. Suitable rubber caps to prevent leakage are provided. The sheath fenestrated on the convexity is used in contracted irritable bladders or where the lesions are in the fundus or on the trigone. The concave sheath is used for the upper portions and side walls. The size of the sheaths is 25 Charrière.

PUNCH FORCEPS (FIG. 53).—The blades (A) are cup-shaped with rather sharp cutting edges. The shank (B) consists of spirally wound flexible wire. There is a scissors handle (C) which opens and shuts the blades. This instrument is useful for extracting small stones and crushing them if soft. It can also be used for obtaining

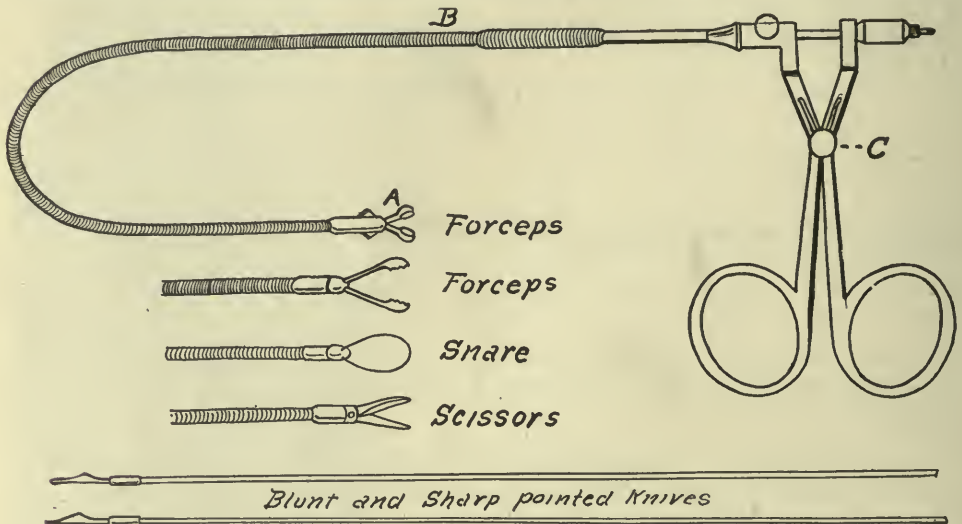


FIG. 53.—INSTRUMENTS USED WITH OPERATING CYSTOSCOPE.

specimens of suspected tissue for examination. I advise against the use of forceps in which the blades are supported on slender, flexible steel rods which are liable to snap off while the instrument is manipulated in the bladder. Very recently in a case of ureteral calculus projecting from the ureteral orifice, the removal of which was contemplated with this kind of forceps, in testing the instrument before use, one of the blades snapped off. If this had happened in the bladder its removal might have proven troublesome or, if another forceps were not available, injury and perhaps perforation of the bladder might have resulted.

THE SNARE (FIG. 53).—The snare is used for removing papillomata and pieces of tumor tissue for examination. It can also be used for removing foreign bodies and small calculi.

KNIVES (FIG. 53).—The blades are either sharp or dull-pointed and are fixed on a long flexible handle. The former are used for incising cysts and the latter for ureteral meatotomy.

SCISSORS (FIG. 53).—These are similar to the forceps except that cutting blades are provided. This instrument is used for ureteral meatotomy and is superior to the knife for this purpose.

Removal of Calculi, Foreign Bodies and Pathological Tissue for Examination.

—The instruments necessary are the operating cystoscope and the punch forceps or snare.

1. Prepare the patient for cystoscopy.
 2. Introduce the sheath with the obturator.
 3. Remove the obturator, wash, and fill the bladder.
 4. Introduce the telescope with a perforated rubber cap on the catheter outlet.
 5. Turn on the current and locate the foreign body or lesion.
 6. Introduce the forceps into the sheath and advance it into the bladder.
- Guide the end of the forceps to the lesion with the deflecting lever.

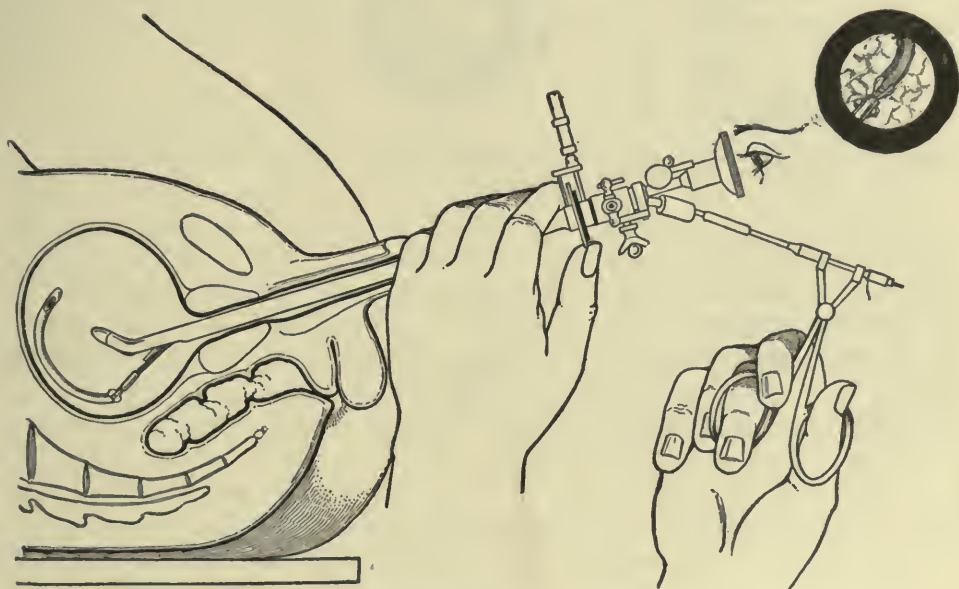


FIG. 54.—REMOVAL OF A PIECE OF CATHETER THROUGH AN INDIRECT OPERATING CYSTOSCOPE.

In case of calculus, it is grasped by the forceps and drawn to the fenestrum. The clutch holding the telescope is then loosened and the telescope is withdrawn from the sheath about $\frac{1}{2}$ in. The calculus or foreign body, if not too large, is withdrawn from the sheath with the telescope. If the stone is too large, try to chip off a piece. If this fails, pick it up again and, securing a firm grasp, slowly withdraw it with the cystoscope from the bladder. Be sure that the beak of the cystoscope is turned up.

In removing a piece of catheter grasp one end and draw it through the sheath with the telescope (Fig. 54). In a case seen recently the bladder contained a piece of catheter $2\frac{1}{2}$ in. long of 14 French caliber. It has been in the bladder for about a month and had given rise to a severe cystitis. Cystoscopy showed it lying transversely in the fundus, encrusted with salts. The bladder held but

3 oz. and was very sensitive. On account of the extreme irritability of the bladder, I could not reach one end, so I applied the blades to the middle and drew it out with the entire instrument. In passing through the deep urethra, the catheter, being brittle, broke in two, and remained in the deep urethra. A urethroscopic tube was passed into the urethra, showing both ends projecting into the bulbous portion. These were easily removed with the forceps (see Urethroscopy).



FIG. 55.—DILATING URETERAL ORIFICE WITH FORCEPS THROUGH OPERATING CYSTOSCOPE. A, Cystoscopic view of dilatation.

To obtain specimens of suspected pathological tissue for microscopic examination, the forceps is guided to the lesion and the blades are firmly closed over it. The sharp cutting edges of the forceps bite out a sufficiently large piece for study.

The snare is used in the same way as the forceps except that the loop is placed around the pedicle of the tumor and tightened. A small calculus is removed in the same way. A piece of catheter may be similarly extracted by tightening the loop around one end of the catheter.

Dilatation of the Ureteral Orifices.—The passage of a descending urethral calculus may often be facilitated by the injection of oil or glycerin into the ureter or by dilating it with catheters, forceps, or with the dilating olivary electrodes of Buerger.

1. INJECTION OF OIL OR GLYCERIN.—The patient is prepared for cystoscopy. The catheterizing cystoscope is introduced and the bladder filled. The suspected ureter is then catheterized, using a catheter with only one terminal

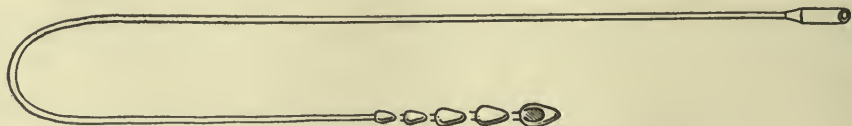


FIG. 56.—OLIVARY ELECTRODES FOR DILATING THE URETERAL ORIFICES.

opening. This is passed directly to the obstruction or if possible beyond it. About 25 min. of sterile glycerin are then injected through the catheter into the ureter, with a small piston syringe. If the patient complains of pain, the injection is discontinued. The same amount of 10 per cent. gomenol in olive oil can be used instead and causes no pain, which is sometimes the case with glycerin. While injecting, the ureteral orifice should be watched and if much leakage occurs, another catheter should be passed alongside of the first, thus more completely blocking the outlet. These injections can be repeated every

day if the patient tolerates instrumentation well. No anodynes or antispasmodics should be administered.

DILATATION WITH CATHETERS.—The ureter can be dilated by passing a number of catheters or filiforms into it. Three are generally used; oil or glycerin may in addition be injected through one of them. An operating cystoscope having a single large catheter channel is necessary. Single catheters of varying size may be used instead. The ureter may also be dilated with the punch forceps. After insertion into the ureter, the blades are opened, thus stretching the orifice (Fig. 55).



FIG. 57.—HOW TELESCOPE AND ELECTRODE ARE INSERTED INTO THE CYSTOSCOPIC SHEATH.



FIG. 58.—SHOWING OLIVARY ELECTRODE ENGAGING URETERAL ORIFICE.

DILATATION WITH OLIVARY ELECTRODES.—Buerger originated this method. I have never used it, but its simplicity warrants its trial. Buerger finds it superior to the other methods.

TECHNIC.—The electrode consists of an olive attached to a wire which is connected to one pole of the high-frequency machine. A No. 9 French silk catheter serves as insulating material to cover the wire. The metal olives vary in size from 6 to 16 French. The largest olive is flattened to permit its exit through the fenestra of the cystoscope (Fig. 56).

The operating cystoscope is used. The instrument having been introduced, the telescope with the dilating olive is attached as follows:

“The catheter shank is fitted with a properly selected rubber cap and introduced into the telescope through the catheter outlet, its screw end projecting a centimeter or more beyond the lens prism (Fig. 57). A suitable olive is now selected and attached. The telescope with its olivary dilator is now inserted into the sheath, the olive first entering, the telescope following. When the olive reaches the fenestra, it slips out and the telescope may be locked in place. The bladder is now filled, the olive pulled back into proper place and then made to enter the orifice of the ureter just as a ureteral catheter (Fig. 58). Where an obstruction or stenosis has been previously determined, it is well to begin with an olive no larger than No. 6. This is made to penetrate the orifice until it reaches the obstructing point. A current of from 300 to 400 milliamperes

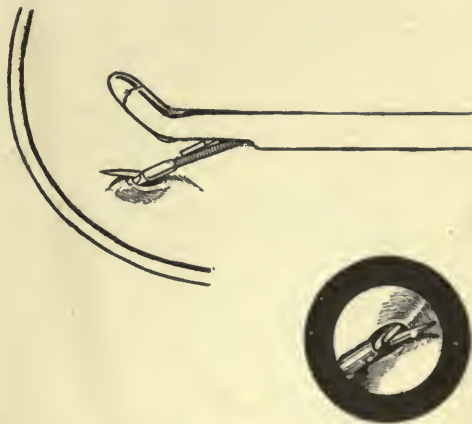


FIG. 59.—URETERAL MEATOTOMY. Cystoscopic view.

is now brought into action, the olivary end being pushed with slight force against the obstructing point. A very few seconds' time usually suffices to bring about enough dilatation to permit the olive to slip by. The ostium of the ureter, unless it is congenitally small, may thus be dilated in a very few seconds even in cases where the center of the olive is firmly arrested. The telescope is removed, the olive detached and a larger one employed. The process is then repeated. We must remember that the large dilators are flattened in one diameter, so that they must be turned in the proper axis for escape from the sheath.

"It is surprising with what rapidity dilatation of the ureteral ostium in the bladder can be brought about, and how quickly obstructions situated higher in the ureter will give away under this treatment."

Synchronous Catheterization of Three Ureters. —Although the presence of three ureters is a rare occurrence, this condition may exist. The three ureters can be catheterized through the large catheter channel of an operating cystoscope which readily admits three ureteral catheters.

CHAPTER VI

FUNCTIONAL TESTS OF THE KIDNEYS

DAVID GEIRINGER

Classification of Functional Tests.—The functional efficiency of the kidneys is usually determined by means of the following methods:

1. **TESTS OF EXCRETORY CAPACITY.**—These consist of the qualitative and quantitative estimation of certain substances in the urine, such as *dyes*—methylene blue, indigocarmin, rosanilin, phthalein—and *other chemicals*—potassium iodid, lactose, salicylates, sodium chlorid, urea, sugar following phloridzin, and enzyme diastase.

2. **TESTS OF RETENTION.**—Through the quantitative determination of the concentration of certain substances in the blood: *ions*, through electrical conductivity; *molecules*, through cryoscopy; *urea*, *incoagulable nitrogen*, and *cholesterin*.

3. **RESPONSE TO PHYSIOLOGICAL STIMULATION: POLYURIA TEST OF ALBARRAN.**

Object of Functional Tests.—The various functional tests often help to decide the following:

- (1) The amount of work both kidneys are doing.
- (2) The amount of work each kidney is doing.
- (3) Which kidney is diseased?
- (4) If both kidneys are diseased, which is the more advanced?
- (5) If nephrectomy is performed, will the remaining kidney prove sufficient to sustain life?
- (6) The advisability of performing other operations, especially upon the aged and in cases of chronic urinary obstruction due to hypertrophy of the prostate.

Indications for Functional Tests.—Long before functional tests came into use, the surgeon always carefully considered the condition of the kidneys when major operations of any kind were contemplated, because the high mortality following operation upon patients with impaired kidneys showed that when the kidneys were diseased, an operation of any kind might be sufficient to overtax their excretory capacity and cause death through urinary suppression. As a

result, advanced renal disease was always considered a sufficient contra-indication to any operation except in case of emergency.

When operation upon some part of the urinary tract is contemplated, experience has shown that it is even more essential to know the functional ability of the kidneys, since operations of this character are so frequently followed by renal failure. This applies especially to operations upon the lower urinary tract in long-standing obstruction due to prostatic enlargement, associated so frequently with varying degrees of dilatation of the ureters and kidneys with infection of these organs.

Finally, in operations upon the kidneys, the estimation of the functional efficiency of each kidney, considered in conjunction with the clinical examination, often assists us to decide not only the advisability of surgical interference, but also the type of operation. Only in this way can such surgical disasters as the removal of a kidney when its fellow is absent, or so completely destroyed by disease as to be non-functionating, be avoided.

Although successful results have been obtained by operation upon cases with bilateral renal disease, where the outlook seemed hopeless, the functional tests should always be employed, not merely to demonstrate an impaired renal function, for that may already be obvious clinically, but to decide, if possible, whether the function is impaired to such an extent that operative interference can be done with some degree of safety.

Preliminaries to Examination.—(1) The kidneys should not be palpated before the test, Schrieber having frequently observed transitory albuminuria beginning within 10 minutes and lasting 2 hours after palpation.

(2) The patient should not eat for at least 2 hours prior to the test, because polyuria frequently follows a meal and may last for 2 hours (Albarran).

(3) A 24-hour specimen should be collected and analyzed before the test.

(4) Catheterized specimens should be subjected to chemical, microscopic, and bacterial examination.

Preparation of the Patient for the Test.—If the combined functional capacity of both kidneys is to be determined, the patient voids, after which a catheter is passed into the bladder to insure thorough emptying. The catheter is left in place until the first appearance of the drug.

In patients without urinary obstruction the catheter is withdrawn after the first appearance of the dye in the urine, the patient being instructed to void into a receptacle at the end of 1 hour, and into another at the end of the second hour. In prostatic cases the catheter is left in place throughout the test. After the dye appears the catheter is corked. The cork is removed at the end of the first and second hour, the specimens are collected in separate vessels. The bladder should be thoroughly emptied each time. The amount of the drug excreted is then estimated.

When the functional efficiency of each kidney is to be determined separately, the patient is prepared for cystoscopy and the ureters are catheterized. The cystoscope is withdrawn, leaving the catheters in position. If only 1 side

can be catheterized, a small urethral catheter is passed into the bladder after withdrawing the cystoscope and leaving the 1 ureter catheter in position. In this way the separate urines are obtained. The largest sized ureter catheter should be used to prevent leakage. The No. 6 or 7 French, flute-end catheter of Albarran is usually sufficient.

Many methods have been devised to determine the functional efficiency of the kidneys. Many of the tests have been discarded because they are unreliable; others are too complicated or too difficult to perform to be of practical value. Some of the new tests require much study in order to form definite conclusions as to their value. Here only those tests will be considered which experience has shown to be generally accurate and reliable. These include:

1. The quantity of urine.
2. Urea.
3. Cryoscopy.
4. Methylene blue.
5. Indigocarmin.
6. Phloridzin.
7. Phenolsulphonaphthalein (phthalein).
8. Experimental polyuria.

QUANTITY AND QUALITY OF URINE

The quantity of urine and its specific gravity very often indicate which kidney is diseased. A diseased kidney usually eliminates less urine and urine of lower specific gravity than its healthy fellow. There are, however, many exceptions. From numerous clinical observations Albarran found that polyuria of a sound kidney is nearly always the rule when its mate is seriously diseased, its degree depending upon the amount of destruction of the parenchyma of the diseased kidney. If the destruction is not extensive, as in the early stages of renal tuberculosis, the output from the diseased side may be almost equal, or there may even be a relative polyuria from the diseased side, due to the pathological stimulation or irritation produced by the diseased area and its toxins upon the remaining healthy parenchyma. It is in these cases that Albarran's polyuria test may prove of value in determining the relative renal efficiency. Sometimes the catheterized specimens show one kidney secreting a large amount of dilute urine, and the other a small amount of concentrated urine. Other tests are then necessary to interpret these findings.

It should also be borne in mind that the quantity of urine excreted by a normal kidney is subject to many variations. The kind of food, the amount of fluid consumed, exercise, fever, and the climate are a few of the many causes for these variations. Moreover, the method of examination may cause irregularities in the rate of flow; thus, after ureter catheterization a reflex anuria may occur. This may last 10 minutes even when the kidney is normal. If it lasts

longer than 10 minutes, the kidney is diseased, and if it continues more than 30 minutes, the kidney is probably non-functionating. Occasionally, instead of anuria, a **reflex polyuria** occurs after catheterization, in which case the rate of flow is markedly increased, the urine being light in color and of low specific gravity. If an ounce of urine quickly escapes as soon as the catheter is advanced up into the ureter, this means dilatation of the ureter or pelvis with retention, occurring in uronephrosis or pyonephrosis and should not be confounded with reflex polyuria.

From the foregoing it will be seen that the quantity of urine excreted by a kidney is not a reliable index as to its integrity. It is only of value when there is a marked disparity between the 2 sides, in which case the side excreting less urine may be regarded as the diseased one. Other tests should always be used to confirm these findings.

UREA ESTIMATION

The estimation of urea in catheterized specimens is an excellent test for determining *relative* renal efficiency, but is of little value in determining the actual 24-hour output of a kidney. The urea estimation should always be made in grains or centigrams, and not in percentages, as the latter is apt to convey an erroneous impression of the relative work done.

The various methods for the quantitative estimate of urea, based upon the decomposition of urea by an alkaline solution of sodium hypobromite and a measurement of the nitrogen evolved, although still used for clinical purposes, are inaccurate, owing to the presence of ammonium salts. Because of its greater accuracy, the Marshall method for urea is recommended by Geraghty and Rowntree.

Marshall's Method of Estimating Urea.—This method depends upon the conversion of urea into ammonium carbonate by means of an enzyme prepared from the soy bean, after which the alkalinity is determined by titrating with standard acid, using an indicator which is not appreciably sensitive to carbonic acid.

Marshall's original method gives accurate results but the water extract of the soy bean which is used requires several hours to complete the hydrolytic action; and besides it loses its activity in a few days. These disadvantages have been overcome by Van Slyke, of the Rockefeller Institute, who prepared the enzyme in the form of a dry soluble powder possessing a high degree of activity. The enzyme can be obtained in this form from the Arlington Chemical Co. of New York. It is called Arlco-Urease. Because of these advantages, the modified form of the Marshall method will be described. For the original method, see bibliography.

The enzyme is standardized by Van Slyke's method. One-tenth gram of Arlco-Urease dissolved in 1 c. c. of water and added to 5 c. c. of 1 per cent. solution of pure urea will hydrolyze .0168 gm. of urea, yielding .00953 gm. of ammonia, which is equivalent to 28 c. c. of fiftieth normal acid, in 15 minutes

at 25° C., or in correspondingly less time as the temperature approaches 50° C. as a maximum.

TECHNIC OF UREA DETERMINATION IN URINE.—Dilute the urine ten times. Take 5 c. c. of the diluted urine for analysis. Add to this in a 100 c. c. test tube a few drops of caprylic alcohol, or 1 c. c. of amyl alcohol or kerosene to prevent subsequent foaming; then add 1 c. c. of a 15 per cent. solution of Arlco-Urease. Close with stopper and allow to stand until the reaction is complete. Allow 15 minutes at 20° C. (68° F.) or ten minutes at 25° C. (79° F.). The tube is then connected through its stopper with a second tube containing 25 c. c. of fiftieth normal hydrochloric acid. Aërate the digestion mixture for half a minute after the reaction is complete and before the tube is opened in order to prevent loss of possible ammonia fumes in the upper part of the tube. Open tube and add dry potassium carbonate (4 to 5 gm.), close quickly and aërate for 15 minutes. To complete the analysis, titrate the acid solution to neutrality with fiftieth normal sodium hydroxid, using as indicator 1 drop of a 1 per cent. sodium alizarin sulphonate solution. The number of cubic centimeters of fiftieth normal acid neutralized by the ammonia from the urea is multiplied by .12 to give the percentage of urea in the urine.

TECHNIC OF UREA DETERMINATION IN THE BLOOD.—Five c. c. of freshly drawn blood are mixed in a 100 c. c. test tube with 1 c. c. of 5 per cent. potassium citrate solution to prevent clotting. Add a few drops of caprylic alcohol to prevent foaming during subsequent aëration. Add 1 c. c. of a 10 per cent. solution of Arlco-Urease. The remainder of the procedure is the same as described under urine, except that only 10 c. c. of fiftieth normal acid need ordinarily be used. Multiply the number of c. c. of fiftieth normal acid neutralized by .012 to give the percentage of urea. A very simple and practical apparatus for titration and aëration is supplied by Emil Gruener, of New York.

The Ambard Urea Constant.—Prior to the investigations of Ambard, attempts had been made to determine the functional efficiency of the kidneys by estimating the urea content of the blood and urine. Little was gained from these studies, however, until 1910, when Ambard introduced a method by means of which the amount of urea *entering* the kidney (urea of the blood) could be compared at the same time with the urea *coming out* of the kidney (urea of the urine). In *normal* cases his experiments showed that:

(1) There is a fixed relation between the urea in the blood and the urea in the urine even under variable conditions of diet, exercise, temperature, fluids, etc.

(2) When the urea increases in the blood, it increases proportionately in the urine.

(3) The amount of urea in the urine varies in proportion to the square of the urea in the blood.

Having determined these facts, he devised the following formula in order

to obtain a numerical constant which by its variations would indicate the degree of the excretory power of the kidneys.

$$\sqrt{\frac{\text{Ur.}}{D \times \frac{70}{P} \times \sqrt{\frac{C}{25}}}} = \text{0.070}$$

(NORMAL
CONSTANT)

- Ur. = Number of grams of urea in one liter of blood.
D = " " " " " " " urine.
C = " " " " " " the urine of 24 hours.
25 = " " " " " normally eliminated in 24 hours.
P = Weight of the patient in kilos.
70 = Average weight of normal adult in kilos.

- TECHNIC OF TEST.—(1) Place patient on table.
(2) Empty bladder with a catheter, *noting the exact time when the bladder is completely empty.* Plug end of catheter.
(3) Ten minutes after bladder is empty, collect 6 c. c. of patient's blood from one of the superficial veins of the forearm.
(4) Exactly 1/2 hour after bladder has been emptied remove plug from the catheter and collect urine excreted during that period.
(5) Determine the amount of urea present in 5 c. c. of the blood and in the 1/2 hour specimen of the urine. To obtain the factor Ur. multiply the amount of urea in 5 c. c. by 200. To obtain factor C multiply the urea in half hour specimen by 48. The urea estimations of the blood and urine are made preferably by the Marshall method. Abroad, the hypobromite method and Ivon ureometer are used.

- (6) Substitute these factors in the formula and calculate the constant.
RESULTS.—In a series of experiments in animals, Ambard concluded that when the constant rose above 0.070, the excretory capacity of the kidneys was correspondingly diminished. Thus:

When the constant is 0.070,	the functional renal efficiency =	$\frac{100}{100}$
" " " " 0.140,	" " " " =	$\frac{25}{100}$
" " " " 0.210,	" " " " =	$\frac{9}{100}$
" " " " 0.280,	" " " " =	$\frac{6}{100}$
" " " " 0.350,	" " " " =	$\frac{4}{100}$
" " " " 0.420,	" " " " =	$\frac{3}{100}$
" " " " 0.490,	" " " " =	$\frac{2}{100}$
" " " " 0.560,	" " " " =	$\frac{1.5}{100}$
" " " " 0.630,	" " " " =	$\frac{1.2}{100}$
" " " " 0.700,	" " " " =	$\frac{1}{100}$

VALUE OF THE TEST.—Theoretically this test would seem to be the ideal one, as it judges the efficiency of the kidney by its ability to excrete one of the most important end products of metabolism.
Legueu, who applied this test in 800 cases, considers it the most valuable of all the functional tests. He concludes, however, that although it gives

valuable information regarding the excretory power of the kidneys, it should always be considered in conjunction with the clinical examination and the urinary findings. He finds the test of great help when considering the advisability of operation in cases of enlarged prostate. In unilateral surgical disease of the kidney his results showed that if the urine of the healthy side gave a constant of 0.11, the diseased kidney could be safely removed.

Widel, Austin and Barbosa likewise find this test of unquestionable value. On account of its great delicacy, Widel advises its use in nephritis, especially in early cases.

CRYOSCOPY OF THE URINE AND BLOOD

The freezing-point of a solution varies in proportion to its molecular concentration. The higher the concentration the lower the freezing-point, and, conversely, and the lower the concentration, the higher the freezing-point. The freezing-point may be designated by the letter Δ .

The Δ of normal urine varies between -1.3° C. and -2.2° C. The test depends on the theory that, when the kidneys are diseased, fewer molecules of solids are excreted, bringing the Δ higher than -1.3° C., that is, nearer to 0.0° C., the Δ of distilled water. A Δ of urine higher than -1.0° C. is regarded as abnormal.

The Δ of normal blood is $-.56^{\circ}$ C. and remains remarkably constant. Koranyi and Bernard found that, later when the function of a kidney was impaired, it eliminated less solids, which consequently accumulated in the blood and lowered its Δ . When this point is below $-.60^{\circ}$ C., the kidneys are diseased. Bernard introduced comparative cryoscopy of the blood and urine, which has proven of more value in determining the renal functional capacity.

In severe bilateral renal diseases, the molecular concentration of the blood is raised and its Δ is lowered, while the concentration of the urine is low and its Δ is correspondingly high. In disease of 1 kidney, these changes in the Δ are much less constant.

Apparatus.—The cryoscopic apparatus consists of a jar (Fig. 1, A), which is filled with ice and salt. In this jar is placed a tube containing equal parts of glycerin and water (B). Within this tube is placed a still smaller tube (C), which contains the fluid whose Δ is to be determined, and a Beckmann's thermometer graduated to every hundredth of a degree centigrade

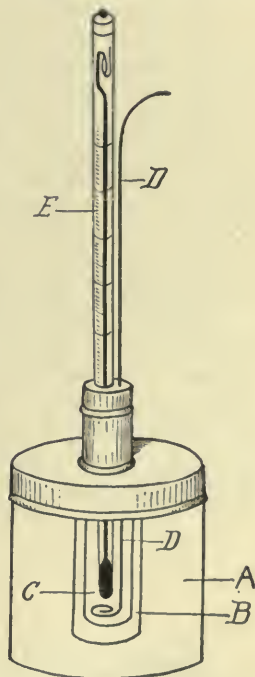


FIG. 1.—CRYOSCOPIC APPARATUS. A, Outer jar filled with ice and salt; B, inner jar filled with glycerin and water; C, small tube containing blood or urine, thermometer and spiral wire; D, platinum spiral for agitating the specimen; E, Beckmann's thermometer.

(E). The thermometer is surrounded by a platinum spiral having a long handle, which is used to agitate the liquid (D).

TECHNIC.—Fill the jar (A) with ice and salt and the outer tube (B) with glycerin and water. The inner tube (C) is filled with enough urine or blood to cover the bulb of the thermometer. As the level of the mercury falls to zero, the fluid must be constantly agitated with the spiral. The mercury will then sink to quite a low point, after which it will fluctuate rapidly and then rise to a point where it will remain stationary. This is the Δ of the blood or urine.

Results.—According to Kummell and Rumpel:

1. When the kidneys are normal, the Δ of the blood remains constant at -0.56° C.
2. A unilateral kidney lesion does not change the Δ of the blood.
3. A bilateral kidney lesion lowers the Δ of the blood and elevates the Δ of the urine.
4. When the Δ of the blood falls below -0.6° C., both kidneys are impaired and nephrectomy is contra-indicated.

Guiteras concludes:

1. When the Δ of the blood and the Δ of the urine of the opposite kidney are both normal, it is safe to remove the affected kidney.
2. When the Δ of the blood is normal and that of the opposite kidney falls below normal limits, only a conservative operation should be performed, for example, nephrotomy instead of nephrectomy.
3. When the Δ of both the blood and the urine of the opposite side are abnormal, only the most conservative operations should be performed and only in extreme necessity.

The clinical applicability of results obtained by cryoscopy, though in the main correct, have been frequently disproven. According to Keyes, Jr.:

A normal Δ of the blood is no absolute proof of renal efficiency, nor is a Δ of -0.60° C., a contra-indication to nephrectomy, in support of which he cites the following: In Israel's case, the Δ of the blood was -0.55° C., although one kidney was destroyed and the other pyonephrotic. Wiebrecht reports a case of single kidney almost destroyed by tuberculosis, with a blood Δ of -0.56° C. Koranyi himself reports a case of unilateral pyonephrosis, in which the blood Δ was -0.68° C. before nephrectomy and -0.57° C. afterward.

THE METHYLENE BLUE TEST

Technic.—Achard and Castaigne first introduced this test. The drug is administered by the intramuscular injection of 15 minims of a 5 per cent. solution. In health the dye appears in the urine in about 15 minutes as a chromogen, the presence of which can be demonstrated by adding 15 drops of acetic acid to each test tube receiving the separate urines and heating them from time to time. A bluish green color denotes the appearance of the chromogen. In normal cases the blue color should appear in 30 minutes. Its excretion continues in the form of chromogen and dye for 36 to 48 hours and sometimes as long as 6 days, even in health.

Quantitative estimations are made as follows according to the method of Achard and Clerc.

1. Use mixed urine of a 24-hour specimen obtained prior to the test, for diluting.
2. In one beaker place 25 c. c. of the colored urine which has been boiled previously with acetic acid to convert the chromogen into the dye.
3. In a second beaker place 25 c. c. of the mixed 24-hour urine obtained prior to the test.
4. To each of the beakers add a like quantity of water until the blue urine is reduced to a pale tint.
5. To the second beaker add a watery solution of methylene-blue, 1:10,000, from a graduated buret, drop by drop, until the color of the 2 beakers is exactly similar.
6. Note the quantity of methylene-blue which has been used. This corresponds to the amount excreted by the kidney in the 25 c. c.

Results.—The time of appearance is delayed and the duration prolonged when 1 or both kidneys are diseased.

In chronic interstitial nephritis the appearance is slow and the total excretion very much prolonged.

In obstruction of the lower urinary tract its excretion is retarded.

In hypertrophy of the prostate it may not appear for 3½ hours or not at all.

Disadvantages of the Test.—1. The drug undergoes chemical changes in the body and only about 50 per cent. is normally excreted by the kidneys. Occasionally it is completely destroyed and does not appear at all in the urine.

2. In acute and chronic parenchymatous nephritis and amyloid kidney, its appearance and excretion are either frequently normal or accelerated.

3. The time of appearance is slow and its excretion so prolonged that a long period of observation and frequent examinations of the urine are necessary.

4. The color is easily influenced by that of the urine and does not lend itself well to quantitative estimations.

Value of the Test.—The methylene-blue test is not absolutely trustworthy in indicating the functioning capacity of the kidneys and, besides, it consumes much time in its performance. It is useful, however, to determine which kidney is affected by comparing the time of its appearance in the separate urines.

THE INDIGOCARMIN TEST

Haidenhain first used this drug in studying the physiology of the kidney. Voelcker and Joseph proposed its use for testing the renal function. Only 25 per cent. of the dye is excreted by the kidneys. The fate of the remainder is unknown.

Technic.—Twenty c. c. of a 0.4 per cent. solution are injected into the gluteal muscles, or 4 c. c. of a 4 per cent. suspension can be used instead. It appears in the urine as a deep greenish color. The time of appearance is from 15 to 30 minutes in normal cases. The time of excretion is 12 hours in normal cases, but considerable variations exist.

Quantitative estimation is made the same as in the methylene blue test, but is not accurate because of variations produced by the color of the urine.

Results.—In disease of the kidney its appearance and elimination are delayed.

Value of the Test.—On account of the more rapid appearance and quicker elimination of indigocarmin, this test is more valuable than the methylene blue test. It is useful in locating a ureteral orifice and in studying the function and action of a ureter which cannot be catheterized.

THE PHLORIDZIN TEST

Casper and Richter first used this test in the study of renal disease. When phloridzin is injected into the body, sugar appears in the urine after a variable time. Experimentation has proven that the sugar is formed chiefly, if not wholly, in the kidney. This test, therefore, differs from others in that it shows the functional efficiency of the kidney from the standpoint of its glandular activity.

Technic.—Inject 1 c. c. of a 0.5 per cent. solution of phloridzin subcutaneously. This amounts to just 5 mg. of the drug. In normal cases the sugar appears in from 15 to 30 minutes. The glycosuria reaches its maximum in 1 hour and gradually diminishes, disappearing in from 2 to 3 hours. Normally 1 to 2 gm. of sugar are excreted during the test.

The sugar is detected as follows: After catheterizing the ureters, place the end of each catheter into a test tube containing about 5 c. c. of Fehling's solution. The phloridzin is then injected. From time to time the contents of the tube are brought to a boil over a Bunsen burner. As soon as sugar appears, the solution turns red, due to the presence of the reduced cuprous salt.

Quantitative Determination of Sugar.—1. If albumin is present, add a few drops of acetic acid, boil urine and filter.

2. Dilute the specimen with enough water to make a 1:10 solution.

3. Place in a test tube or small beaker 1 c. c. of Fehling's copper solution and 1 c. c. of Fehling's alkaline solution and dilute with 8 c. c. of water.

4. Boil to determine whether the copper solution is already reduced; this will be shown by a red or yellow precipitate.

5. Add the diluted urine to hot Fehling's solution, drop by drop, from a buret graduated in tenths of cubic centimeters, keeping the Fehling near the boiling point. Continue addition until the blue color of the Fehling entirely disappears, which is best determined by allowing the precipitate to settle.

The Fehling's solution should be so prepared that 1 c. c. will be exactly reduced by .005 gm. sugar. Knowing the amount of diluted urine it took to reduce 1 c. c. of Fehling, whose sugar equivalent is .005 gm. to the cubic centimeter, the amount of sugar in the diluted specimen can be readily calculated.

Value of the Test.—In renal disease the glycosuria is either absent or de-

layed in appearance. It is slower in reaching a maximum, and the amount of sugar excreted is diminished.

In chronic interstitial nephritis, the glycosuria is either retarded or does not appear at all, even when no albuminuria is present.

When one kidney is badly diseased, the appearance of sugar is often retarded on the healthy side (Beer).

It is an excellent test for determining which kidney does the better work. When the difference between the 2 sides is very marked, we are justified in assuming that the side showing delayed appearance and low excretion is functionally inefficient. It can furthermore be accepted without exception that an early appearance (15 to 20 minutes) and free elimination of sugar signify a functionally sound kidney. The exceptions reported have all been against the negative findings. Walker has found that in some normal cases no glycosuria followed injection. Keyes has performed a successful nephrectomy upon a case whose total urine showed no sugar until 2 hours after injection.

The test is of no value when a pathological glycosuria is present.

The administration of antipyrin and the salicylates delays the appearance of sugar.

Repetition of the test often causes a more marked reaction.

THE PHENOLSULPHONEPHTHALEIN TEST

This drug was first prepared by Ira Remsen, and Geraghty and Rowntree first used it to study the renal function. It is a bright red crystalline powder slightly soluble in water and readily soluble in solutions of sodium carbonate.

Preparation.—To prepare the solution for use, 0.6 mg. of the drug and 0.84 c. c. of double normal sodium hydroxid solution are diluted with 0.75 per cent. sodium chlorid solution up to 100 c. c. This gives the monosodium or acid salt, which is red in color and slightly irritant locally when injected. It is necessary to add 0.15 c. c. of the double normal hydroxid solution, which changes the color to a Bordeaux red. This preparation is non-irritant and can be injected subcutaneously or intramuscularly without causing irritation and also intravenously without causing toxic symptoms.

This solution can be obtained, already prepared for injection, in ampules containing a little more than 1 c. c. Each cubic centimeter contains 6 mg. of phenolsulphonephthalein. It is put up by Hynson Westcott & Co., of Baltimore.

I. Estimation of the Combined Work of Both Kidneys.—**TECHNIC (GERAGHTY AND ROWNTREE).**—1. To insure a free urinary flow, give the patient 300 c. c. of water to drink a half hour before the test.

2. Inject 1 c. c. of phthalein solution (6 mg.) subcutaneously into the upper arm. **Note time of injection.**

3. Insert catheter into the bladder and thoroughly empty it.

4. Place the end of the catheter into a test tube containing a few drops of 25 per cent. sodium hydrate.

5. Note the time when the first pinkish tinge is seen in the test tube. Normally it appears within 5 or 10 minutes.

In patients without urinary obstruction the catheter is withdrawn at the

time of the first appearance of the dye in the urine. The patient is instructed to void into a receptacle at the end of 1 hour after the appearance of the dye and into a second at the end of the second hour. In prostatic cases it is wise

to leave the catheter in place until the end of the observation. The catheter is corked at the time of the appearance of the drug and the cork is removed at the end of the first and second hours. Each time the bladder should be

thoroughly drained. The percentage amount of the drug excreted in the 2 periods is then estimated as follows.

QUANTITATIVE ESTIMATION.—

Either the Duboscq or the Geraghty and Rowntree modification of the Hellige colorimeter may be used to estimate the quantity of the drug excreted. On account of the simplicity and ease of manipulation the latter is preferred (Figs. 2 and 3).

1. Fill the wedge-shaped cell with the standard solution, made by diluting exactly 1 c. c. of phenolsulphonephthalein solution with 200 c. c. of water, adding 10 c. c. of a 5 per cent. solution of sodium hydroxid and sufficient water to measure one liter.

2. Dilute the specimen to 200 c. c. with water and render alkali-

line with 10 c. c. of 5 per cent. solution of sodium hydroxid, then further dilute the alkaline urine with sufficient water to make one liter. Enough of this dilution should be clarified by filtration to fill the rectangular cup to the mark that will be found upon it.

3. The back of the apparatus is then manipulated by turning the screw

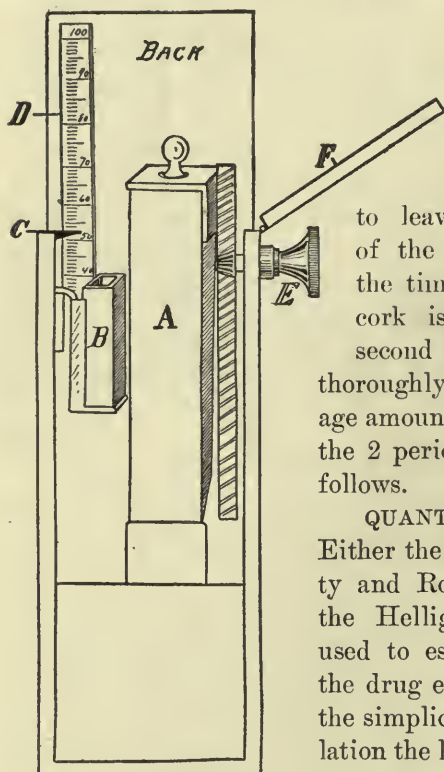


FIG. 2.—GERAGHTY AND ROWNTREE COLORIMETER. The front has been removed to show the interior of the box. A, Wedge-shaped flask filled with standard solution; B, rectangular cell in which colored urine is placed; C, indicator; D, scale showing percentage of phthalein contained in cell B; E, screw for raising and lowering the back of the box; F, top of box.

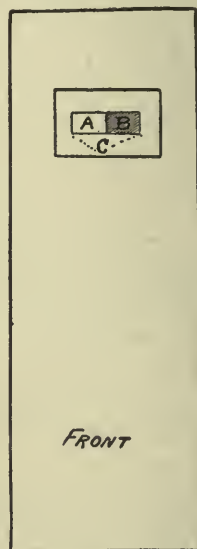


FIG. 3.—FRONT OF COLORIMETER. C, Window containing prism through which the standard solution is compared with the specimen.

(Fig. 2, E) until the colors as seen through the prism are identical, when the percentage of excretion will be directly indicated on the scale.

If, after adding the alkali, the coloration of the specimen is slight, showing small excretion of phthalein, then the dilution should be carried only to 250 or 500 c. c. and the readings on the scale divided by 4 or 2 as the case may be.

RESULTS.—The amount of water excreted has no influence on the amount of the dye eliminated. It is immaterial, so far as the appearance and excretion of the drug are concerned, whether the urinary output is 50 or 500 c. c.

NORMAL CASES.—When 6 mg. were injected, the dye appeared in from 5 to 11 minutes; 40 to 60 per cent. were excreted in the first hour, and 20 to 25 per cent. in the second hour, making a total of 60 to 85 per cent. for the 2 hours.

ACUTE NEPHRITIS.—In 5 cases that were studied, the appearance of the dye was retarded and the output diminished.

CHRONIC PARENCHYMATOUS NEPHRITIS.—In a series of 25 cases, there was no evidence of increased permeability. All showed retarded appearance and diminished excretion, corresponding to the severity of the clinical condition. In long-standing cases this was very marked.

CHRONIC INTERSTITIAL NEPHRITIS.—In cases considered clinically mild, the reduction in the amount of dye was small. In advanced cases the reduction was marked.

DIABETES MELLITUS.—There was no deviation from the normal. One case of diabetes insipidus showed a slightly decreased excretion.

HYPERTROPHY OF THE PROSTATE AND OBSTRUCTION IN THE LOWER URINARY TRACT.—It was found that when the obstruction was of short duration, with a small amount of residual urine, and in those cases leading a regular catheter life, there was but little delay and slight reduction in excretion. Long-standing cases showed a marked delay with decided decrease in excretion.

ENLARGED PROSTATE.—A study of the renal condition in cases of enlarged prostate by the phthalein test revealed the following:

1. In the majority of cases there is more or less renal impairment.
2. When the urinary excretion is free, a delay beyond 20 or 30 minutes in the time of appearance of the dye is suggestive of markedly decreased permeability.
3. A marked decrease in the amount eliminated invariably means severe derangement of renal function.
4. When the appearance is delayed beyond 25 minutes and the output is below 20 per cent., operation is postponed regardless of the clinical condition.

Estimation of the Work Done by Each Kidney.—**TECHNIC.**—1. twenty minutes prior to the test the patient drinks 600 to 800 c. c. of water.

2. The ureters are then catheterized, using the flute-end catheter of Albarran, No. 6 or 7 French. The cystoscope is withdrawn, leaving the catheters in position.

3. A small urethral catheter is passed into the bladder, which is emptied, so that if leakage occurs it can be detected.

4. A specimen of urine is collected from each side for chemical and microscopical examination.

5. Place 1 drop of 25 per cent. sodium hydrate solution in the test tubes receiving the separate urines.

6. Inject 6 mg. of the drug subcutaneously, noting the time.

The time of appearance of the drug is then noted and the collection is continued for 1 hour from the time that the dye first appeared in the urine. The output for the second hour is collected in a separate vessel. The amount of the dye excreted by each kidney is then estimated as previously described.

RESULTS.—In normal cases the appearance of the drug is practically simultaneous from both kidneys. Occasionally a difference of 2 or 3 minutes has been noted. From 5 to 10 minutes is the average time of appearance, when the solution is injected subcutaneously and from $3\frac{1}{2}$ to 7 minutes after intramuscular injection.

When one kidney is diseased, the time of appearance is delayed on the diseased side. The amount excreted is not only relatively but absolutely diminished.

Value of the Test.—Phenolsulphonephthalein is well adapted for functional testing because of its early appearance and the rapidity and completeness of its elimination.

Quantitative estimation of the amount excreted is simple and accurate.

The permeability of the kidney for this drug is diminished in chronic parenchymatous and interstitial nephritis.

The test is of value in determining the true renal condition in cases of prostatic obstruction.

In unilateral and bilateral disease, the relative and absolute amount of work done by each kidney can be determined when the urines are obtained separately.

Reliance should be placed only upon the quantity excreted during a period of at least 1 hour. The amount of delay in appearance is of much less value.

Intramuscular Method.—The technic is exactly the same as for the subcutaneous method, except that the dye is injected into the lumbar muscles. The dye appears more rapidly (3.5 to 7 minutes) than in the subcutaneous method (5 to 11 minutes), and about 5 to 10 per cent. more is excreted with the intramuscular method than with the subcutaneous. Less variation exists in the amount excreted by normal individuals; thus, after subcutaneous injection, 40 to 60 per cent. is eliminated in 1 hour, while after intramuscular administration 58 to 68 per cent. is excreted in the same time.

The intramuscular method is recommended in preference to the subcutaneous methods of administration by Geraghty and Rowntree, Keyes, and others, because of the more rapid appearance of the dye in the urine and its more constant excretion.

Intravenous Administration.—In a series of cases studied by Keyes in which the dye was injected intravenously, the results were as follows:

In 14 normal cases the time of appearance varied from 2 to 9 minutes.

The amount excreted in	5 minutes was	6.5 per cent. in 1 case.
" " " "	10 " "	9 to 18 per cent. in 2 cases.
" " " "	15 " "	5 to 17.5 per cent. in 10 cases.
" " " "	20 " "	5 to 47 per cent. in 2 cases.
" " " "	30 " "	24.4 to 28 per cent. in 2 cases.

In 38 diseased kidneys the time of appearance averaged 8 minutes.

The amount excreted in 10 minutes was	1.5 to 14.9 per cent.	Average 10 p. c., 10 cases.
" " " " 15 " "	0 to 17.5 "	" 7 " 21 "
" " " " 20 " "	0 to 31 "	" 17 " 12 "
" " " " 30 " "	0 to 19.7 "	" 9.6 " 6 "

This would seem to be the ideal method of performing the test, as it cuts down the time of observation from 2 hours to 30 minutes, were it not for the fact that differences exist between the amount of work done by both kidneys when observations are made for only short periods. According to Albarran and Kapsammer, even under normal conditions the difference might be 30 per cent. in 15 minutes, while if prolonged to 1 hour it decreases to 10 per cent. Besides there are certain technical difficulties which interfere with the accuracy of this method of performing the test. It is often impossible to be certain that the dye has been injected into the vein, especially in stout subjects and in women. Another difficulty is that on account of the great excretion in the first 15 minutes, unless great care is exercised in collecting and handling the specimens, the quantitative estimations will not be accurate.

ALBARRAN'S EXPERIMENTAL POLYURIA TEST

This test is based upon the following principles:

1. The quantity and quality of the excretion of a diseased kidney are more constant and subject to less variation than the quantity and quality of the excretion of its healthy fellow, and the more extensively its parenchyma is destroyed, the less does its function vary.

2. When one kidney is diseased and the other is healthy or less diseased, the response to additional work or physiological stimulation (for example, the drinking of several glasses of water) is more marked in the healthy or less diseased kidney.

Technic.—Albarran catheterizes only one side, using a ureter catheter, size 6 to 7 French. He tests its tightness by injection of a colored fluid. He obtains the urine from the opposite kidney by a catheter placed in the bladder and left there throughout the test. He throws away the urine passed in the first 10 minutes and then collects and measures the urine subsequently passed as follows:

1. Amount obtained in the first half hour from each side. At the end of the first half hour the patient drinks 3 glasses of water.
2. Amount passed in second half hour from each side.
3. Amount passed in third half hour from each side.
4. Amount passed in fourth half hour from each side.

In this way 8 specimens of urine are obtained, each representing the work of a single kidney for $\frac{1}{2}$ hour.

The stimulation resulting from the water drunk begins in the second half hour, reaches a maximum in the third half hour and begins to subside in the fourth period.

Results.—When one kidney is diseased the amount of fluid from the healthy side rises rapidly in the second and third periods and then gradually falls. That from the diseased side rises relatively but little or not at all. Therefore, if prior to the test the diseased kidney has been secreting more urine than its healthy fellow, this difference is overcome or diminished by the greater activity on the sound side. If, however, the healthy kidney secreted more urine prior to the test, this difference will be more marked for the same reason. The urea and chlorids are slightly increased on the sound side, but much less in proportion to the fluid increase.

When both kidneys are diseased, the healthier kidney always excretes relatively more fluid and solids.

Value of the Test.—Although not all cases respond as accurately as described by Albarran, this test is conceded by all to be a valuable diagnostic measure, in that it serves to show some of the reserve force of the kidneys.

According to Keyes, Geraghty, and others, it is not always possible to elicit polyuria by administration of large amounts of water, nor is it always possible for a healthy kidney to overcome the polyuria of a diseased kidney present prior to the test.

PRACTICAL VALUE OF FUNCTIONAL TESTS

1. All of the tests indicate only the excretory capacity of the kidneys at the time that the test is made.

2. None of the tests indicate the anatomical condition of the kidney. Considered by themselves, they do not make the diagnosis nor settle the prognosis.

3. The phthalein test comes nearer giving an accurate idea of the actual work the kidneys are doing than any of the others.

4. The phloridzin test comes next in value. It is perhaps too delicate, as it sometimes exaggerates the pathological condition.

5. The polyuria test of Albarran is of value only when it demonstrates a marked difference in the response of each kidney to physiological stimulation. It is a useful confirmatory test.

6. Cryoscopy is unreliable because the scale of variation of the freezing point of the blood is very limited, whatever may be the condition of the kidneys, while, on the other hand, the freezing point of the urine varies very widely even in the normal individual under conditions which are perfectly physiological.

This accounts for many of the erroneous results obtained by comparative cryoscopy of the blood and urine, especially when only one kidney is diseased.

7. Methylene-blue and indigocarmin rank next to phthalein and phloridzin. Their excretion is prolonged and they do not lend themselves to quantitative estimation.

8. The Ambard constant requires further study to determine its final position. It should be used as a confirmatory test.

Functional tests should never be solely relied upon in judging the condition of a diseased kidney and that of its mate, nor should they alone decide for or against operation. They should, however, always be used in conjunction with the clinical history, the general physical examination, cystoscopy, routine examination of the 24-hour and catheterized specimens, and careful microscopic search for the presence of pus, blood, bacteria, and tumor elements. Used in this way, they often materially aid in the diagnosis, prognosis and selection of lines of treatment.

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CHAPTER VII

THE SALVARSAN THERAPY OF SYPHILIS

DAVID GEIRINGER

Up to the year 1900 very few scientific advances had been made in the understanding and treatment of syphilis. In 1903 Metchnikoff, by transmitting the disease to apes, placed it among the infectious diseases, thus opening the way for work along modern lines. Very soon afterward, in 1905, Schaudinn discovered the specific spirochete and in 1906 Wassermann gave us a means of serum diagnosis. In 1910 Ehrlich had prepared an arsenical compound for the treatment of syphilis which he called salvarsan.

For a long time arsenic had been used in the treatment of syphilis. It could not, however, be given in sufficiently large doses to produce any profound therapeutic effect because of its toxic properties. Various synthetic products were used with but indifferent success, for example, arsenious acid, sodium cacodylate, atoxyl, soamin, and arsacetin. It remained for Ehrlich and his co-worker, Hata, to prepare an arsenical compound which could be given in large enough doses to have an active antisyphilitic action without producing the toxic symptoms heretofore obtained. This product he called salvarsan, "606."

Salvarsan, "606" (Dioxydiamido-arsenobenzenedihydrochlorid) is a yellow crystalline hygroscopic powder, very unstable when exposed to air. It is very soluble in water, yielding a solution strongly acid in reaction. Its chemical formula is $C_{12}H_2 N_2 O_2 As_2 \cdot 2HCl + 2H_2O$. It contains 31.57 per cent. arsenic.

Methods of Administration.—Salvarsan is administered as follows:

1. By intramuscular injections.
 - a. In alkaline solutions.
 - b. In neutral suspension.
 - c. In oily emulsion.
2. By intravenous injection of alkaline solutions.
3. By intraspinal subarachnoid injections.

Dosage of Salvarsan.—For intramuscular injection, the average doses are: For men and women, 0.3 to 0.6 gm. = 5 to 10 gr.

For children, 0.2 to 0.3 gm. = 3 to 4½ gr.

For suckling infants, 0.02 to 0.05 to 0.1 gm. = ⅓ to ¾ to 1½ gr.

It is sometimes given in fractional doses of 0.1 gm. suspended in oil. These injections are made every second day until a total maximum dose of 1.2 gm. is reached.

For intravenous injection the doses are slightly smaller:

For women, 0.3 to 0.4 gm. = $4\frac{1}{2}$ to 6 gr.

For men, 0.4 to 0.5 gm. = 6 to $7\frac{1}{2}$ gr.

Salvarsan is obtained from the manufacturers as a yellow powder contained in sealed glass ampules in different doses, viz.:

0.6 gm. approximately 9 gr.

0.3 gm. approximately $4\frac{1}{2}$ gr.

0.2 gm. approximately 3 gr.

0.1 gm. approximately $1\frac{1}{2}$ gr.

INTRAMUSCULAR INJECTION OF SALVARSAN

Preparation of Alkaline Solution for Intramuscular Injection.—As salvarsan gives an acid solution when dissolved in water, a 15 per cent. solution of sodium hydroxid is used to render it alkaline. This is prepared by dissolving 1.5 gm. of purified sodium hydroxid in 8.5 c. c. of distilled water.

The following table gives the amount of this solution necessary to obtain the correct degree of alkalinity when different doses of salvarsan are used:

For 0.6 gram salvarsan	about 1.14 c. c.	sod. hydroxid sol.	(23-24 drops)
" 0.5 "	" "	0.95 "	" " (19-20 ")
" 0.4 "	" "	0.76 "	" " (15-16 ")
" 0.3 "	" "	0.57 "	" " (12 ")
" 0.2 "	" "	0.38 "	" " (8 ")
" 0.1 "	" "	0.19 "	" " (4 ")

EQUIPMENT NECESSARY.—The following instruments and materials are required:

Small mortar, capacity 1 oz.

Glass stirring rod.

Record syringe.

Hypodermic syringe.

Glass pipet graduated in minims or hundredths of a centimeter.

Sol. 15 per cent. sodium hydroxid.

Dilute hydrochloric acid.

Tincture green soap.

Tincture iodine.

PREPARATION.—In the preparation of the injection strict asepsis must be observed throughout. The mortar, stirring rod, and pipet are boiled before using. The ampule is placed in 95 per cent. alcohol and wiped dry with a sterile towel.

Assuming that the dose to be injected is 0.5 gm., the contents of an ampule of salvarsan containing this amount are placed in the mortar. The 15 per cent. sodium hydrate solution is then added. Reference to the foregoing table gives the necessary amount, which in this case is 19 drops or 0.95 c. c. Five c. c. of distilled water are then added, and the solution is stirred with the glass rod until all of the salvarsan has dissolved.

Preparation of the Neutral Suspension.—This method, although rarely used at the present time, still finds employment by some. The salvarsan powder (0.5 gm.) is placed in the mortar and 8 drops of the soda solution added. It is then diluted with either 5 or 10 c. c. of distilled water. The suspension is then tested with litmus paper. According to the reaction, a drop of either the soda solution or dilute hydrochloric acid is carefully added until a neutral suspension is obtained.

Preparation of Oily Emulsions.—These are prepared by adding the required dose of salvarsan to 4 or 5 c. c. of a sterile bland oil, for example, 01. Sesame, 01. Amygdal. dulei. Iodypin 10 per cent. (an iodine addition compound of sesame oil) is an excellent vehicle.

The salvarsan powder is rubbed up with the oil in a small mortar until a smooth emulsion is obtained. It is then ready for injection. No sodium hydrate solution or water is added.

Preparation of the Patient.—The site of injection is rendered sterile by painting with iodine or by scrubbing thoroughly with green soap and water and washing with alcohol and 1:1,000 bichlorid.

The most favorable site of injection is the upper and outer quadrant of the gluteal region (Fig. 1 (1)). Some make the injection into the lumbar muscles, selecting a point about 3 in. above the iliac crests (Fig. 1 (2)). The region of the sciatic nerve should be carefully avoided.

Having selected the point of injection, local anesthesia is obtained by injecting a few drops of either 4 per cent. novocain or 2 per cent. alypin, intradermically, until a small wheal is raised. The needle is then inserted deeply into the muscle and 1 c. c. of the anesthetic is injected. Anesthesia is produced in 5 minutes.

The Syringe.—The Record syringe (Fig. 2) is an excellent one for making either watery or oily injections of salvarsan. The needle is 14 gauge and 1½ in.

long. The syringe is sterilized by boiling. It should be taken apart before boiling; otherwise the increased expansion of the metal piston may crack the glass barrel.

Technic of Injection.—Having prepared the patient and the salvarsan solution, the needle of the Record syringe is quickly introduced through the skin, deeply into the gluteal muscles. The surgeon should wait a few moments to determine if a blood-vessel has been entered or punctured, in which case blood

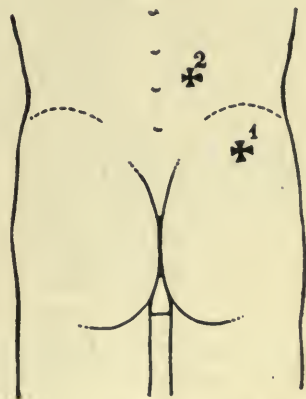


FIG. 1.—SHOWING SITES FOR INTRAMUSCULAR INJECTIONS OF SALVARSAN AND NEOSALVARSAN.

will escape from the needle. Should this occur, withdraw the needle and after flushing it out insert it in a different direction. The salvarsan solution or

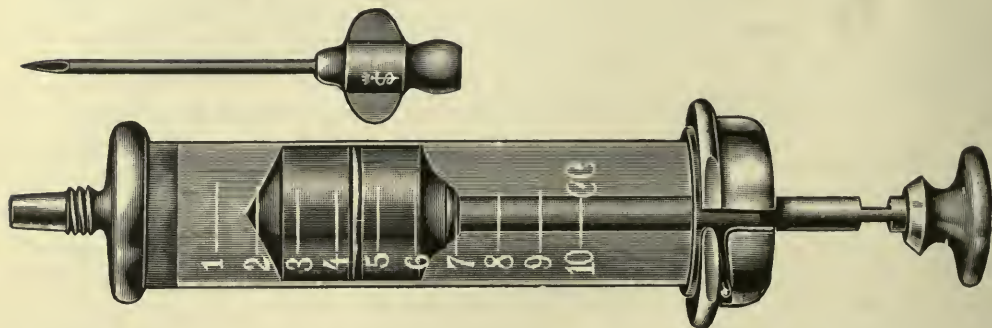


FIG. 2.—EHRlich-HATA SYRINGE FOR INTRAMUSCULAR INJECTION. The needle is composed of platinum-iridium and is 14 gauge in caliber. (Kny Scherer.)

neutral suspension is then drawn up into the barrel of the syringe, and, after expelling the air, the barrel is affixed to the needle. The injection should be

made very slowly to avoid tearing and hemorrhage in the muscles. During the injection the patient will sometimes complain of pain radiating down the thigh to the inner side of the knee.

When the oily injections are used, the technic of injection is a little different. Unless certain precautions are taken, the undissolved salvarsan is apt to clog the needle. This can be prevented as follows: Having inserted the needle, pick up the barrel with the left hand, placing the left index finger over the outlet, which points downward. Continue stirring the emulsion with the glass rod. Having obtained a smooth mixture, quickly pour it into the syringe barrel (Fig. 3). The piston is then inserted and all air expelled by turning the barrel up-

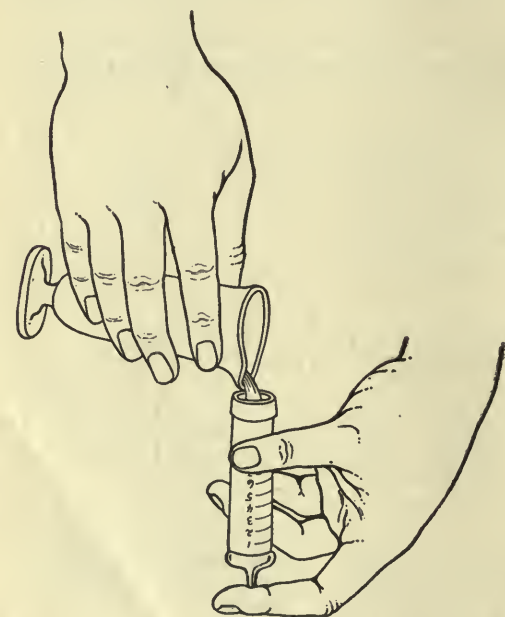


FIG. 3.—SHOWING HOW THE BARREL OF THE SYRINGE IS FILLED WITH OILY SUSPENSION OF SALVARSAN.

ward and advancing the piston. The barrel is then affixed to the needle and the injection slowly made.

After-treatment.—After injection, the part should be gently massaged and the puncture wound covered with a sterile gauze dressing. After the effect of

the local anesthetic wears off, pain is felt. This is usually quite intense. It may be relieved by a hot water-bag or hot compresses of lead and opium, with the internal administration of the following:

℞		
Codein sulphate	gr. $\frac{1}{4}$	015
Pyramidon	gr. v.	3
Aspirin	gr. v.	3
M. Ft. cap.		
Sig. One capsule every four hours.		

The alkaline injection sometimes causes great pain, requiring a hypodermic of morphin. The oil emulsion is much less painful.

Collateral Phenomena.—Within a few hours a variable amount of swelling takes place at the site of injection, reaching its height usually in 24 to 48 hours. It then gradually subsides so that in from 10 to 14 days the induration is reduced to a small nodule which slowly disappears. At first the induration is quite sensitive to the touch and the skin over it often pits on pressure.

In the beginning, when salvarsan was given either in alkaline solution or neutral suspension, numerous cases of abscess and extensive necrosis were reported, especially when the injection was made subcutaneously. The neutral suspension was responsible for most of these and for that reason is but rarely used at the present time. The alkaline solution and the oily emulsion enjoy most favor at the present time. Should abscess or necrosis occur, it should be freely incised, evacuated and treated like ordinary abscess. Personally I prefer the oily emulsion, using 10 per cent. iodipin as a vehicle, except in those cases in which iodine idiosyncrasy exists. In these, sterile alboline containing one dram of lanolin to the ounce is an excellent base.

Precautions to Be Observed.—1. Observe strict asepsis throughout.

2. Prepare solution or emulsion just before use. A good time to prepare the salvarsan is while waiting for the local anesthetic to take effect.

3. Use a large caliber needle when injecting the emulsion.

4. If blood escapes from the needle, re-insert it in a different location to prevent embolism.

5. Inject the salvarsan slowly and deeply into the muscle so that none escapes into the subcutaneous tissues, thereby preventing painful indurations, fat necrosis, and sometimes abscess.

6. Use only the contents of a freshly opened ampule. Never prepare more than 1 injection at a time. Under no circumstances should the contents of a tube damaged in transportation or any remnants of the powder from previously opened tubes be used.

INTRA-VENOUS ADMINISTRATION OF SALVARSAN

Apparatus and Solutions Required.—1. Narrow-necked glass-stoppered bottle, graduated, capacity 300 c. c., containing about 50 glass beads.

2. Glass funnel.
3. Sterile, freshly distilled water.
4. 0.5 per cent. saline solution made of chemically pure sodium chlorid and freshly distilled water.
5. A glass pipet graduated in minims or hundredths of a centimeter, capacity 30 minims, or 2 c. c.
6. Irrigating apparatus (2 graduated cylinders, capacity 300 c. c., and rubber tubing).
7. One Schrieber needle, Navy needle, Begg needle.
8. Green soap.
9. Tincture of iodine.
10. 1:1,000 bichlorid of mercury solution.
11. 2 per cent. alypin solution.
12. 15 per cent. chemically pure sodium hydrate solution.
13. Scalpel, needle, ligatures, scissors, infusion cannula, hypodermic syringe.

Sterilization.—The instruments and apparatus are all sterilized by boiling. The salvarsan ampule is placed in 95 per cent. alcohol and dried with sterile gauze.

Preparation of Alkaline Salvarsan Solution for Intravenous Administration.

—1. Place 40 c. c. of sterile freshly distilled water into the graduated bottle containing the glass beads.

2. Add the contents of an ampule of salvarsan, for example, 0.5 gm.

3. Shake vigorously until all the salvarsan is dissolved. The solution must be absolutely clear and contain no undissolved particles and no gelatinous drop-like bodies, when held to the light, before the soda solution is added.

4. To this clear solution add 19 drops of a 15 per cent. solution hydroxide solution (see page 182). This causes a precipitate to form which dissolves on shaking. The soda solution should not be added drop by drop, but should be poured into the flask in one lot. Should the resulting solution not be clear or become turbid after a few moments, add a few drops of the soda solution, a drop at a time, waiting 2 or 3 minutes after each drop to see if this quantity suffices to clear the solution.

5. To this clear yellow solution add enough of the sterile saline solution to make 250 c. c. The temperature of the saline should be 40° C. Each 50 c. c. of the solution contains 0.1 gm. or 1½ gr. of salvarsan.

Preparation of the Patient.—The patient should take a saline cathartic (Epsom salts, Carabana water, etc.) in the morning and partake of a light breakfast (rolls and coffee).

The site of injection is sterilized as described previously. This should include the flexure of the elbow and about 5 in. of the arm and forearm. If necessary, the parts should be shaved. It is advisable to have both arms prepared.

Technic of Injection.—The irrigating cylinders are then suspended, so

that their lower ends are about 3 ft. above the bed or table, with the clamps, A, B, D, Figure 4, closed. The salvarsan solution is poured into one cylinder and the saline into the other. The next step is to expel all the air from the tubes. This is accomplished as follows: Open clamps A and D and allow about 30 c. c. of the saline to escape. Then tighten clamp D. What little air remains in the tube is driven out by compressing the rubber tubing a few times until gas bubbles are no longer seen escaping through the saline solution in the cylinder. Clamp A is then tightened and clamp B is opened. The salvarsan solution then flows into the other limb of the Y tube (c). The air is expelled by compressing that part of the tube. Clamp B is then closed. The surgeon should practice this with plain water before injecting a patient.

It is alleged by some surgeons that if a small amount of air is injected into a vein no harm will result. As it is impossible to tell just how much air there is in the tubes, it is best to be on the safe side and expel all.

The injection is made by inserting the needle into one of the superficial veins in the bend of the elbow. The median cephalic or median basilic is usually most accessible. Sometimes the cephalic or the basilic is more easily located (Fig. 5).

The veins are rendered more prominent by tying loosely a tourniquet about 5 in. above the elbow with a slip knot. A 3-in. bandage serves the purpose. It should not be tied too tightly. Having located a good-sized vein, steady it between the thumb and forefinger of the left hand. The needle is then inserted through the skin and passed under it for about $\frac{1}{4}$ in. in the same direction as the vein. The handle end of the needle is then given a slight upward tilt, which causes the point to impinge against the vessel. The needle is then slowly pushed through the wall of the vein. As the needle pierces the vessel wall, a slight resistance is felt, which ceases as soon as the lumen is entered. The needle is then slowly advanced through the vein for about $\frac{1}{4}$ in. If its lumen has been entered, blood

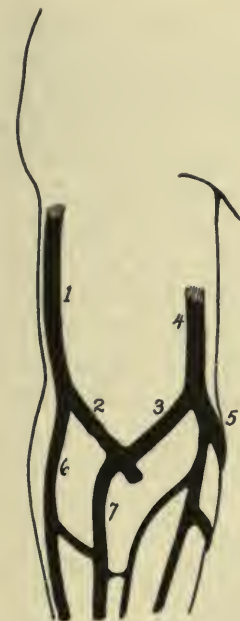


FIG. 5. — SUPERFICIAL VEINS IN BEND OF ELBOW. 1, Cephalic; 2, median cephalic; 3, median basilic; 4, basilic; 5, ulnar; 6, radial; 7, median.

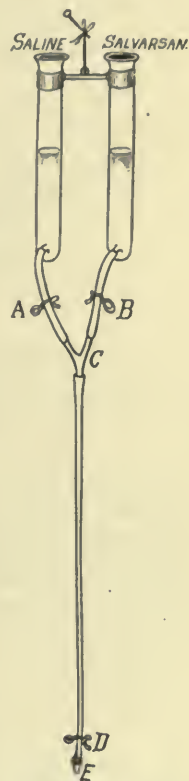


FIG. 4. — APPARATUS FOR INTRAVENOUS INJECTION. It consists of two glass cylinders, capacity 300 c. c.; rubber tubing; three clamps (A-B-D); C, a Y tube; E, a metal coupling.

will flow from the needle.

Steadying the needle with the left hand, the tourniquet is loosened. Clamps

A and D (Fig. 4) are then opened and while the saline is flowing the end of the tubing is connected by means of the coupling E (Fig. 4) with the needle (Fig.

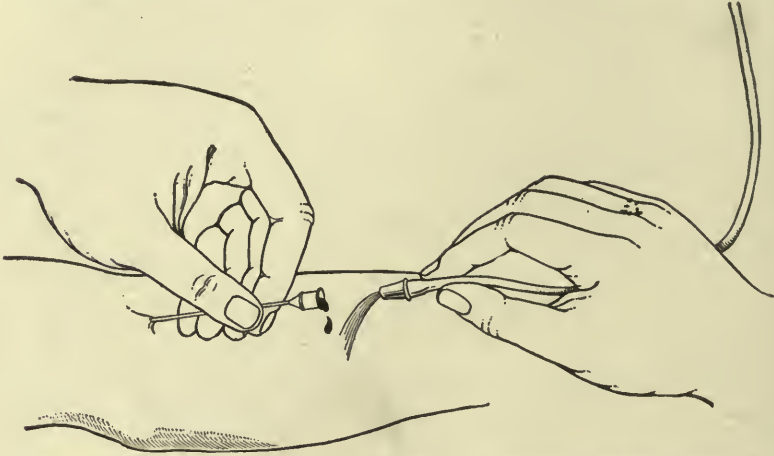


FIG. 6.—SHOWING HOW INJECTION APPARATUS IS CONNECTED WITH THE NEEDLE.

6). If the vein has been properly entered, there will be a free flow of saline without causing any swelling or pain at the site of injection. If an increasing swelling is noticed at the site of injection, the needle should be withdrawn, washed out, and inserted in a different vein. The swelling indicates that saline is flowing into the subcutaneous tissues instead of into the vein. This occurs when the needle slips out of the vein or passes through both walls (Fig. 7).

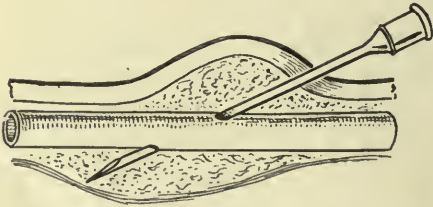


FIG. 7.—SHOWING HOW A SHARP-POINTED NEEDLE MAY PIERCE BOTH WALLS OF VEIN. As a result the solution is injected into the subcutaneous tissues instead of into the vein. When this occurs, the patient will complain of a burning pain at the site of injection.

When the saline flows through satisfactorily, tighten clamp A and open clamp B (Fig. 4). The salvarsan solution will then flow into the vein. While this is going on, the needle should be steadied to prevent it from slipping out. When the level of the salvarsan solution reaches the bottom of the cylinder, tighten clamp B and open clamp A (Fig. 4), allowing about 20 c. c. of the saline to flow through, thus injecting into the vein whatever salvarsan there is in the tubing.

The needle is then withdrawn and the

puncture wound covered with sterile gauze and a bandage which are removed in 24 hours.

Usually there is no difficulty in entering a vein. The surgeon should bear in mind that even in stout subjects the veins lie just beneath the skin, being separated from it by a thin layer of loose connective tissue.

Occasionally difficulty is encountered in stout subjects who follow sedentary occupations and in female patients. In these the veins are often very small and

are entered with great difficulty. In these cases a needle of very fine caliber should be used in making the puncture. If, after several attempts, failure results, it is advisable to go to the other arm, select the most prominent vessel, and



FIG. 8.—SHOWING VEIN EXPOSED BY DISSECTION WITH TWO LIGATURES PASSED UNDER IT.

infiltrate the skin over it with 2 per cent. alypin. The skin is then incised and, after exposing the vein, 2 ligatures are passed under it (Fig. 8). The vein is then nicked and an infusion cannula passed into its lumen. The proximal ligature is tightened over the vein and cannula and the distal ligature also tied. Connect the cannula with the injection apparatus and make the injection as previously described.

Other forms of injection apparatus are used. Some employ only 1 cylinder, dispensing entirely with the saline solution. Others who use only 1 cylinder first pour about 3 oz. of saline into it and, having successfully entered the vein, as shown by the flow of saline into it, then pour the salvarsan solution into the cylinder and proceed to make the injection. The 2-cylinder apparatus is recommended because the saline flow can be stopped as soon as it is determined that a satisfactory puncture has been made.

Instead of employing the gravity method, the injection can be made with a syringe. This consists of a Record syringe with a detachable valve head having an inlet and an outlet. To the inlet opening of the valve head a rubber tube is attached, the other end being placed in the vessel containing the salvarsan solution. To the outlet opening another tube is attached which is connected with the needle. By drawing the piston back the syringe is filled, and as it is pushed forward again the contents are injected into the vein (Fig. 9).



FIG. 9.—METHOD OF MAKING INTRAVENOUS INJECTION WITH SYRINGE APPARATUS.

Many different types of needles have been designed to facilitate entering the vein. The following models will be found serviceable:

1. The Schrieber needle (Fig. 10) is made with either a sharp or a dull point. The former is best for subjects having small veins. The latter is most

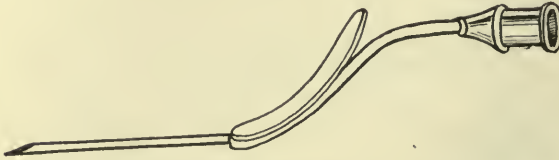


FIG. 10.—SCHRIEBER NEEDLE.



FIG. 11.—NAVY NEEDLE.

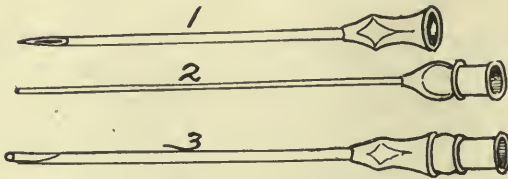


FIG. 12.—BEGG NEEDLE.

useful when the vessels are large and prominent. When the dull-pointed needle is used, there is less danger of piercing both walls of the vein.

2. The Navy needle (Fig. 11) was designed by Capt. Vickery, U. S. N. It is a dull-pointed needle, 14 to 16 gauge. Its point is bent slightly forward. It is an excellent needle when the vein is large and prominent.

3. The Begg needle (Fig. 12) consists of 2 parts: (1) An outer sharp-pointed sheath 2 in. long, 18 gauge; (2) an inner tube, 20 gauge. The needle

is inserted through the skin into the vein. When blood flows, showing that its point lies in the lumen of the vessel, the inner tube is passed through the needle until its dull point projects a little beyond the sharp point of the needle (Fig. 12 (3)). The inner tube is then connected with the injection apparatus. This needle was designed to avoid piercing the opposite wall of the vein while the injection is being made, thereby avoiding the painful infiltrations which result if the solution escapes into the subcutaneous tissues.

After-treatment.—After injection the patient should stay in bed for at least 12 hours. A convenient time to give the injection is in the afternoon or early evening, allowing the patient to get up in the morning and resume his business. The practice of giving intravenous injections in the office and allowing the patient to get up is dangerous when large dilutions are used.

Collateral Phenomena.—There is usually a distinct rise of temperature, sometimes preceded by a chill. It usually begins about 2 hours after injection and averages from 101° to 102.5° F. Cases are reported in which the temperature has risen to 105° F. It gradually falls, rarely lasting more than 48 hours. Sweating is sometimes pronounced. If the injection is given shortly after a meal, nausea and vomiting frequently occur.

The pulse is usually accelerated with the temperature. In some cases the

blood-pressure drops suddenly after administration of the drug, and the heart action becomes slow and feeble. For this reason it is advisable that patients be kept in the recumbent position after injection. Auer has shown that the heart might be so affected that a slight extra strain would throw it into fatal fibrillation. He attributes this to an inherent weakness of the cardiac muscle brought out by the injection of salvarsan. His experiments give support to Ehrlich's contention that myocarditis should be regarded as a contra-indication to the intravenous administration of the drug. This cardiac disturbance may be partly due to the large amount of fluid suddenly thrown into the circulation. No such disturbance has been noted when the injection is made with concentrated solutions of neosalvarsan.

NEOSALVARSAN, "914"

This substance, which was prepared according to Ehrlich's directions, is a true derivative of salvarsan. It was introduced into the therapy of syphilis in October, 1911. It is a condensation product of formaldehyd sulphoxylate of sodium and salvarsan, and contains as its active constituent dioxidyamidoarsenobenzine-monomethane sulphinate of sodium ($C_{12}H_{11}O_2As_2N_2.CH_2O.SONa$). Its arsenic content is less than that of salvarsan, 1.5 gm. corresponding to 1 gm. of salvarsan. It is a yellow powder having a peculiar ether-like odor and dissolving readily in water, giving a neutral solution.

Kersten has shown that the tolerance dose for guinea-pigs is 0.2 gm., as compared with 0.08 gm. of salvarsan. Injection into mice showed it to be decidedly less toxic than salvarsan.

The advantages of neosalvarsan are, in brief, as follows:

1. It is more readily soluble and has a neutral reaction.
2. It is better borne, can be given in larger doses, and is free from the constitutional reactive phenomena following injections of salvarsan.
3. Its therapeutic activity is at least as great as that of salvarsan.
4. It is better adapted for intramuscular injection.

Like salvarsan, neosalvarsan is put up in sealed ampules containing different doses and labeled Dose No. I, II, III, IV, etc.

Dose No. I, containing 0.15 gm. neosalvarsan, corresponds to 0.1 gm. salvarsan.

Dose No. II, containing 0.3 gm. neosalvarsan, corresponds to 0.2 gm. salvarsan.

Dose No. III, containing 0.45 gm. neosalvarsan, corresponds to 0.3 gm. salvarsan.

Dose No. IV, containing 0.6 gm. neosalvarsan, corresponds to 0.4 gm. salvarsan.

Dose No. V, containing 0.75 gm. neosalvarsan, corresponds to 0.5 gm. salvarsan.

Dose No. VI, containing 0.9 gm. neosalvarsan, corresponds to 0.6 gm. salvarsan.

Dosage.—The average single dose is:

For men, 0.6 to 0.75 gm.

For women, 0.45 to 0.6 gm.

For children, 0.15 to 0.3 gm.

For nurslings, 0.05 gm.

As a rule, the dose of neosalvarsan should correspond to the dose of salvarsan which would have been injected in a particular case.

Methods of Administration.—Neosalvarsan may be injected intramuscularly, or administered by the intravenous route.

INTRAMUSCULAR INJECTION OF NEOSALVARSAN

Preparation of Watery Solutions for Intramuscular Injection.—As 1 gm. of neosalvarsan dissolved in 22 c. c. of water gives an isotonic solution, enough water should be added to make approximately a 5 per cent. solution. For each 0.15 gm. neosalvarsan use 3 c. c. of freshly distilled sterile water, that is, if 0.6 gm. is to be injected, use 12 c. c. of water. This is placed in a small beaker and the contents of the ampule added. The solution is gently stirred with a glass rod. The neosalvarsan, being very soluble, quickly dissolves, giving a clear yellow neutral solution. No sodium hydroxid solution should be added.

Preparation of Glycerin Emulsion.—In a small beaker or mortar place 2 c. c. of chemically pure sterile glycerin. Add the neosalvarsan and gently stir until a smooth suspension is obtained. Add 15 drops of a 1 per cent. solution of alypin, or beta-eucain. The addition of the anesthetizing solution causes some of the drug to dissolve, rendering it more suitable for injection.

Preparation of Patient.—The patient is prepared in the same way as described under intramuscular injections of salvarsan. The after-treatment is the same.

Collateral Phenomena.—The injection of the watery solution is very painful. The patient sometimes complains of pain for 2 weeks. Induration is usually marked and may persist for weeks. The glycerin suspension, on the other hand, is much less painful. If the site of injection is carefully anesthetized, no pain is complained of during the injection. When the effect of the anesthetic wears off, pain of quite an intense character is felt. Its duration is much shorter and the induration is much less marked, usually disappearing in a week.

INTRAVENOUS INJECTION OF NEOSALVARSAN

Preparation of Solution.—The preparation of neosalvarsan solution is simple compared with the complicated method which the preparation of salvarsan entails. All that it requires is the addition of water, whereupon it immediately dissolves, giving a clear, transparent, yellow liquid of neutral reaction. Vigor-

ous shaking is to be avoided, because oxidation may occur, causing the formation of oxidation products more poisonous than the drug itself. Freshly distilled water or saline solution is used at room temperature. If saline is used, it must be made of chemically pure sodium chlorid not stronger than 0.4 per cent.; otherwise the solution becomes cloudy. The temperature of the injection solution should not be above 20° to 22° C. (68° to 71° F.).

Technic of Injection.—For intravenous injection use 25 c. c. of freshly distilled water or saline solution is used at room temperature. If saline is used, it 100 c. c. of water are required. The water is placed in a sterile beaker, and the contents of the ampule added. Shake a few times gently, and the solution is ready for use. It is not necessary to filter or to add any alkaline solution.

The preparation of the patient and the technic of injection are the same as with salvarsan. The after-treatment is likewise similar.

Collateral Phenomena.—The injection of neosalvarsan is much better borne than the administration of a corresponding dose of salvarsan. The vasomotor disturbances and congestions during and directly after the injection, the peculiar edematous swellings of the face, the gastric and intestinal disturbances, diarrhea, colic, etc., are either absent or at most occur only to a slight degree. Except for a slight diarrhea and moderate vomiting when maximum doses (1.2 to 1.5 grams) are given, disagreeable complications are absent.

Occasionally, when large doses are administered, harmless medicinal rashes appear from the fifth to the tenth day. The temperature sometimes rises to 99° or 100° F. This occurs most frequently after the first injection in cases with an abundance of spirochetes.

Precautions to Be Observed in the Preparation of Neosalvarsan for Intravenous Administration.—1. Use freshly distilled water.

2. If saline solution is employed, use only chemically pure sodium chlorid, not stronger than 0.4 per cent.

3. The temperature of the injected solution should not rise above 20° to 22° C. (68° to 71° F.). All warming of the neosalvarsan solution must be avoided.

4. The solution of neosalvarsan must not be allowed to stand but must be injected immediately after preparation, as oxidation, with the formation of highly toxic products, takes place even more readily than with salvarsan.

5. The patient should rest quietly for several hours after the injection.

Intravenous Injection of Neosalvarsan in Concentrated Solutions.—For the past 2 years neosalvarsan has been injected intravenously in more concentrated solutions. Ravaut, Duhot, Emery, and Stern were among the first to employ this method. The therapeutic effects seem the same as when larger dilutions are employed, and no unfavorable systemic effects have been noted.

Great care should be exercised in making the puncture to insure against the escape of the solution into the subcutaneous tissues around the vein. To avoid this, saline should always be employed first, to determine that the vein

has been entered; otherwise painful infiltrations which persist for a long time will result.

The following dilutions have proven satisfactory:

For 0.15 gm. neosalvarsan use	5	c. c. distilled water
" 0.3 "	" 10 "	" "
" 0.45 "	" 12½ "	" "
" 0.6 "	" 15 "	" "
" 0.75 "	" 17½ "	" "
" 0.9 "	" 20 "	" "
" 1.5 "	" 35 "	" "

APPARATUS.—The apparatus shown in Figure 13 is recommended. It consists of 2 20 c. c. Record syringes (A and B); 2 pieces of rubber tubing, 3 in. long (C); 1 piece of tubing, 1 in. long (E); a 2-way valve (D); and a coupling for the needle (F).

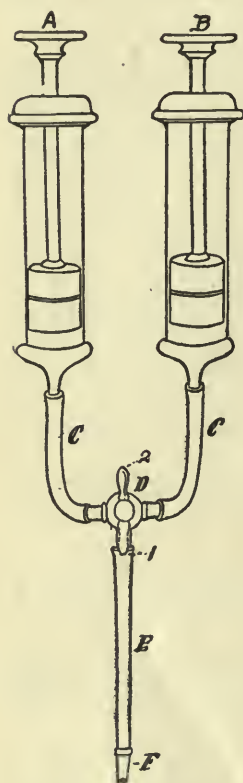


FIG. 13.—AUTHOR'S APPARATUS FOR INTRAVENOUS INJECTION OF NEOSALVARSAN IN CONCENTRATED SOLUTION.

TECHNIC OF INJECTION.—Syringe A is filled with normal saline. Syringe B is filled with the neosalvarsan solution, prepared by dissolving 0.9 gm. in 20 c. c. of freshly distilled water at room temperature. If smaller doses are used, correspondingly less water is employed.

Having filled syringe B with the neosalvarsan solution, connect it with 1 inlet of the valve D by means of the rubber tubing C. Expel air by advancing the piston into the barrel until some of the solution escapes from the outlet of the valve. The handle of the stopcock should be in position 2. Swing the handle of the stopcock to position 1. Fill syringe A with normal saline and connect it with the valve D. Attach coupling and tubing to the outlet of the valve. Expel air by injecting the saline into the tubing until it escapes from coupling F.

Having inserted the needle into the vein, connect it with the syringe by means of the coupling F. Inject the normal saline to determine if the puncture has been properly made. Usually 2 or 3 c. c. suffice. If the saline flows satisfactorily, swing the handle of the valve back to position 2, which opens the way for the neosalvarsan, which is then very slowly injected, the injection consuming from 5 to 8 minutes (Fig. 14).

These injections may be given in the office or in the dispensary. After receiving the injection, the patient remains in a reclining position for 15 minutes, after which he is allowed to go home.

INTRASPINAL INJECTIONS IN THE TREATMENT OF SYPHILITIC AFFECTIONS OF THE CENTRAL NERVOUS SYSTEM

The results following the administration of salvarsan alone, or of salvarsan in combination with mercury and the iodids, in the treatment of cutaneous, visceral, and bone syphilis are very satisfactory. Syphilis of the central nervous system has responded much less favorably. Although recent cases at times

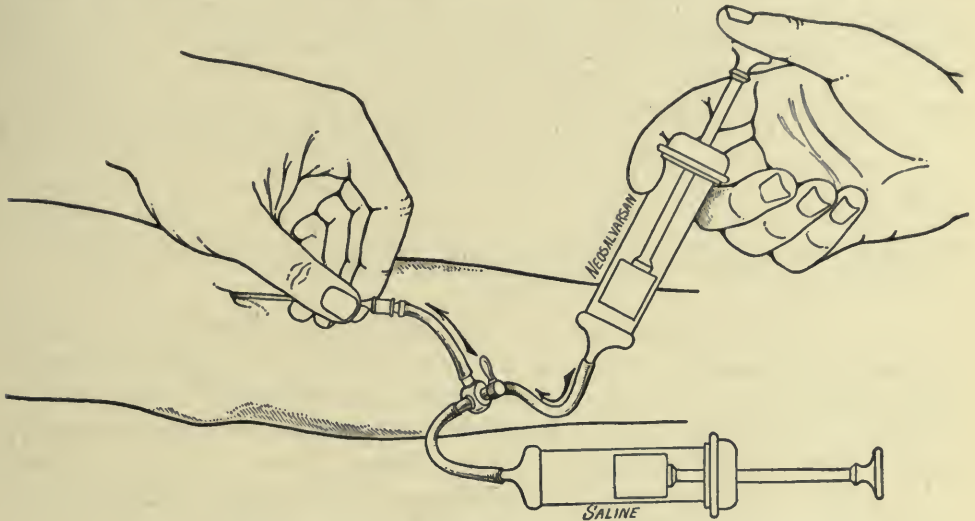


FIG. 14.—TECHNIC OF INTRAVENOUS INJECTION WITH AUTHOR'S APPARATUS.

show rapid clinical improvement, the more chronic conditions show but little or no beneficial effects. Even when clinical improvement has been noted, with also a negative blood Wassermann reaction, the abnormal constituents of the cerebrospinal fluid were but little influenced as shown by the persistence of a high cell count, increased globulin, and a positive Wassermann. The inefficacy of salvarsan in these conditions has been partly explained by Uhlmann, whose studies serve to show that salvarsan and certain other substances, when administered intravenously, scarcely if at all reach the ventricular fluid, whereas such substances injected into the subarachnoid space readily reach the ventricles.

With a view to a more radical attack upon the disease, the introduction of salvarsan directly into the cerebrospinal fluid suggested itself. Marinesco injected 5 mg. of neosalvarsan dissolved in 4 c. c. solution in a series of 13 cases. Although improvement was noted in some, he strongly advises against this method, because the drug is too irritating when used in this way.

Swift and Ellis, working in line with the results obtained by Robertson, who demonstrated that the blood serum of patients treated intravenously with salvarsan had a definite antispirechetal effect, evolved the following method of intraspinal injections:

Technic (Swift and Ellis).—"One hour after the intravenous injection of salvarsan 40 c. c. of blood is withdrawn directly into bottle-shaped centrifuge tubes, and allowed to coagulate, after which it is centrifugalized. The following day 12 c. c. of serum is pipetted off and diluted with 18 c. c. of normal saline. This 40 per cent. serum is then heated at 56° C. for one-half hour. After lumbar puncture the cerebrospinal fluid is withdrawn until the pressure is reduced to 30 mm. cerebrospinal fluid pressure. The barrel of a 20 c. c. Luer syringe (which has a capacity of about 30 c. c.) is connected to the needle by means of a rubber tube about 40 cm. long. The tubing is then allowed to fill with cerebrospinal fluid so that no air will be injected. The serum is then poured into the syringe and allowed to flow slowly into the subarachnoid space by means of gravity. At times it is necessary to insert the plunger of the syringe to inject the last 5 c. c. of fluid. It is important that the larger part of the serum should be injected by gravity and if the rubber tubing is not more than 40 cm. long the pressure cannot be higher than 400 mm. Usually the serum flows in easily under even a lower pressure. By the gravity method the danger of suddenly increasing the intraspinal pressure to the danger point, such as might occur with rapid injection with a syringe, is avoided. Frequently there is a certain amount of pain in the legs, commencing a few hours after the injection. The pain is more often noticed in tabetics than in patients with cerebrospinal syphilis. It can usually be controlled by means of phenacetin and eocodin. Occasionally morphin is required."

The patient is given full doses of salvarsan every 2 weeks and in addition intraspinal injections of 30 c. c. of 40 per cent. serum, until the cerebrospinal fluid shows a normal cell count and a negative Wassermann.

Conclusions.—After 2 years' experience with this method, Swift and Ellis, Asper, and Fordyce and Hough conclude as follows:

1. Many cases showed rapid improvement, both clinically and by the disappearance of pathological elements from the cerebrospinal fluid.
2. Treatment should be continued as long as the cerebrospinal fluid shows evidence of a specific pathological process and should cease only when the fluid has become normal. At the first evidence of relapse treatment should be resumed.
3. This method of intraspinal treatment is recommended in combination with intensive intravenous treatment in rapidly advancing tabes or paresis which has resisted other forms of treatment.

Neosalvarsan has been injected intraspinally by Marinesco, Ravaut, Marie, Levaditi, Beriel and others, in the treatment of paresis. The dosage varies from 0.25 mg. to 6 mg. Opinions differ as to the advisability of this procedure. Many of the patients so treated developed permanent bladder disturbances. Beriel reports a case in which complete retention followed by permanent incontinence of urine and feces with a flaccid paralysis of the legs, developed after an intraspinal injection of 0.2 mg. neosalvarsan. The old salvarsan is entirely too irritating to be injected in even fractions of a milligram.

INDICATIONS FOR SALVARSAN THERAPY

1. Syphilis. Salvarsan and neosalvarsan are indicated in congenital syphilis and in all stages of acquired syphilis.

2. Recurrent fever. In the treatment of this condition the drug may be regarded as a specific.
3. Frambesia. The results of treatment are almost as successful as in recurrent fever.
4. Vincent's angina. The drug is applied by means of a cotton applicator soaked in glycerin and gives excellent results.
5. Trypanosomiasis (sleeping sickness). In the few cases treated thus far the results have been very encouraging.
6. Filariasis, bilharziosis, kala-azar, amebic dysentery. The number of cases treated, though too small to admit of final conclusions, gave encouraging results.
7. Chorea. Severe cases which prove intractable to ordinary treatment occasionally respond favorably.

USE OF SALVARSAN IN PREGNANT SYPHILITIC WOMEN

C. Sauvage (22) sums up the effect of salvarsan on pregnant syphilitic women as follows:

1. Intravenous injections of salvarsan have a remarkably favorable effect upon the accidents of syphilis operative during pregnancy.
2. It assures a healthy issue in most cases. In a number of cases the infants had latent syphilis; others were born malformed.
3. Latent syphilis, or cases which had been irregularly or insufficiently treated, when complicating pregnancy, should be treated with salvarsan.
4. Cases that have been rigorously treated before conception takes place, and in which no active manifestations are present during pregnancy, should be treated with mercury. Salvarsan, while possibly more efficacious in these instances, is more dangerous. Diseases of the liver and kidneys are contra-indications to the use of salvarsan.

HEREDITARY SYPHILIS

Immediate and striking results follow the injection of salvarsan in infants in whom mercury has been used with little or no apparent benefit. The injections are given intravenously and are repeated at intervals for 1 year, even if no symptoms are present, in order to avoid relapses. Mercury and the iodids should be administered in combination with salvarsan.

Dosage.—The dose for infants up to 8 months varies from 0.01 gm. to 0.05 gm. salvarsan (0.015-0.075 gm. neosalvarsan). Above 8 months, from 0.075-0.2 gm. is given, according to age.

The initial dose should always be small and if well borne gradually increased

in succeeding injections. In very severe cases, such as those with pemphigus, extreme wasting, etc., the initial dose should not exceed 0.01 gm.

Holt injects the drug, properly diluted, into the external jugular vein, using a No. 22 gauge needle 1.5 cm. long, attached to a 5 c. c. Luer syringe.

CONTRA-INDICATIONS TO THE USE OF SALVARSAN AND NEOSALVARSAN

The use of both drugs is contra-indicated in the following conditions:

1. All inflammatory ophthalmic disorders of non-syphilitic origin.
2. Patients possessing arsenic idiosyncrasy.
3. Fetid bronchitis.
4. All grave conditions which threaten life—advanced nephritis (non-syphilitic), advanced arteriosclerosis, aneurysm, high fever, and cachexias not due to syphilis. Diabetes, pregnancy, and tuberculosis do not constitute contra-indications unless the general condition is very poor.
5. Special caution should be taken with patients presenting evidences of specific meningitis (headaches) or any other nervous condition which may be dependent upon syphilis. In all such cases, and especially in cerebrospinal syphilis, tabes, and paresis, begin cautiously with small doses, 0.15 gm., and at 8-day intervals increase to 0.3, 0.6, 0.75 gm., only when the injections are well borne.
6. Pernicious anemia. Salvarsan is not only useless, but strikingly harmful.

PROVOCATIVE INJECTIONS OF SALVARSAN

Gennerich and Milan, working independently, observe that the Wassermann reaction becomes more positive after the injection of salvarsan. It stirs up the spirochetes, as it were, and brings their products into the circulation.

Both observers found that, by injecting patients with 0.3 gm. 6 months or a year after an apparent cure, if serum tests were made every day for 2 weeks a positive reaction was obtained if any infection remained, while it continued negative if the cure was absolute.

For practical purposes 2 serum reactions are sufficient. The specimen of blood should be taken in 48 hours after the provocative injection. If it is negative, take another specimen a week after injection. If the patient is cured, the reaction will be negative; if any infection remains, the reaction will be mildly positive.

The practical application of this test is one of the greatest advances in the scientific management of syphilis, in that it makes the Wassermann reaction much more delicate, thus bringing to light obscure and latent syphilis. Such a test should be made in 6 months and again in 1 year after the patient is appa-

rently cured. Treatment should be kept up as long as the serum reaction becomes positive after a provocative injection.

ANAPHYLAXIS TO SALVARSAN

From a study of the toxic effects of salvarsan, Swift concludes as follows:

"After repeated injections of salvarsan, certain patients show symptoms of a respiratory and vasomotor nature like those seen in anaphylaxis. Such an attack comes on usually after 30 to 50 c. c. of the solution have been introduced. There is a facial expression of anxiety, the patient complains of a feeling of pressure in the epigastrium or cardiac region; this is followed shortly by a sense of suffocation, and a number of times the patients have developed a sensation 'as though the heart were in the throat.' Shortly after this there is a bright red suffusion of the skin of the face, most marked about the eyes; at times it involves the entire body. In marked cases the eyelids and lips appear swollen. Occasionally the red color changes to a purplish cyanosis. As a rule there is but little change in the pulse rate, although once it was much increased. The respirations increase slightly in rapidity. The symptoms seem largely vasomotor in nature and usually pass off rapidly on stopping the injection."

Certain other toxic symptoms following intravenous administration resembling those of acute arsenical poisoning have been shown by Wechselmann to be due to the use of stale water or saline containing molds or saphrophytic bacteria. In florid syphilis one frequently sees fever and general malaise following the first injection. This is probably due to the setting free of some toxic substances from the spirochetes.

THE EFFECT OF SALVARSAN TREATMENT UPON THE WASSERMANN REACTION

From the study of the results obtained by Wechselmann, Kromayer, Linser, Gennerich, Schrieber, Noguchi, Craig, and Nichols, the following conclusions may be drawn:

1. Regarding the disappearance of the Wassermann reaction, the best results were obtained in the primary stage, while tertiary cases gave the poorest results.

2. The reaction disappears usually between the second and fourth weeks after salvarsan treatment. It becomes negative most rapidly when treatment is given in the primary stage.

3. The reaction disappears more rapidly after intravenous injection than after intramuscular administration.

4. In patients previously treated for 2 or 3 years with mercury, who still had a positive Wassermann, the reaction quickly disappeared after 2 or 3 injections of salvarsan.

5. The intramuscular method gives the best results regarding relapses and the intravenous the poorest. One intramuscular injection seems to have more curative value than 2 intravenous (Craig). The many relapses occurring in patients who received 1 or 2 injections intravenously prove that at least 4 injections must be given.

6. In a number of cases that were Wassermann negative for 1 and 2 years, the luetin test or the provocative Wassermann demonstrated the presence of the disease.

THE VALUE OF SALVARSAN AND NEOSALVARSAN IN THE TREATMENT OF SYPHILIS

Although Ehrlich's hope of *therapia magna sterilisans* has not been realized, it has been proven beyond a doubt that salvarsan and its derivative, neosalvarsan, are specifics for the spirochete of syphilis. Its specific action depends upon whether or not it can reach the spirochetes. If they are accessible, they will be killed and a cure will result. If they are deeply seated in the tissues away from the direct influence of the drug, they will survive and under favorable conditions multiply and cause relapses.

After administration of the drug, spirochetes disappear from initial lesions, mucous patches, and condylomata within 48 hours. The improvement in the general physical and mental condition is also very striking.

That differences of opinion should exist regarding the results obtained can readily be understood, because of the chronic nature of the disease, appearing as it does in so many different forms and varying degrees of severity. Much confusion has resulted from an attempt to correlate the results of different series of cases, treated by different methods and different doses, with or without mercury and potassium iodid. Notwithstanding that differences of opinion still exist as to the final position of salvarsan in the treatment of syphilis, the opinion is practically unanimous that it is one of the most powerful antisyphilitic agents that we have at present, which, if used in sufficient dosage, quickly gets the case under control and, if used in combination with mercury, materially shortens the time required for the cure of the disease.

No hard and fixed method can be given as to the amount of treatment required to cure syphilis, because the infection varies within such wide limits in different individuals. Each case must be studied separately in deciding upon the dose and the frequency of repetition. Permanent results depend upon the repetition of the dose. Doses should follow one another in such a manner as to continue the improvement. If a relapse is allowed to occur before another treatment, it is easy to understand why failure will result even after an indefinite number of injections.

As experience has shown that relapses are usually more severe when salvarsan has been used alone, the combined treatment is now used. This consists of at least

4 injections supplemented by an intensive course of mercury by injections and inunctions.

When all clinical manifestations have disappeared, the complement-fixation test must be employed to determine the true condition of the patient. To be reasonably sure that he is cured, the test must become negative and remain negative for at least a year. Should doubt arise at any time, the serum reaction should always be confirmed by the luetin and provocative tests.

Regarding the relative value of the intravenous and intramuscular methods of administration, serological tests and clinical observation show that, while the immediate effect of the intravenous method is much more prompt, it is less enduring, owing perhaps to its rapid elimination. According to Craig, of the United States Army, who has had an unusual opportunity to study the results obtained by both methods, 1 intramuscular injection seems to have more curative value than 2 intravenous given at short intervals. On account of the pain and discomfort attending this method, it has been practically abandoned by many for the intravenous route.

According to my own experience, the best results are obtained when treatment is begun with 2, 3, or 4 intravenous injections, the number and dosage depending on the stage of the disease, its clinical severity and the intensity of the blood test. This is followed after variable intervals, usually 1 month, by at least 1 intramuscular injection (glycerin alypin suspension). At the same time an active mercurial treatment is added, consisting of injections and inunctions.

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CHAPTER VIII

DIAGNOSTIC METHODS IN GYNECOLOGY, INCLUDING THE USE OF GYNECOLOGICAL INSTRUMENTS AND THE TECHNIC

GEORGE GRAY WARD, JR.

The methods employed by a specialist in arriving at a diagnosis are characterized by system and thoroughness. He has learned that to be systematic is the only safe way of preventing forgetfulness and failure to investigate every part, and that if he fails to be thorough his opinion is proportionately valueless. A proper understanding of the difficulties that thwart the examiner in endeavoring to make a bimanual investigation of the pelvic cavity is necessary in order that one may intelligently overcome them.

Preliminaries.—Certain preliminaries are essential to success, yet they are frequently ignored in a hurried examination. The bladder must be emptied immediately prior to the examination, as it is obvious that a sac containing half a pint or more of fluid, between the examining hands, will absolutely prevent a proper palpation of the organ. Furthermore, a full bladder normally produces a backward displacement of the uterus to the first degree, and, if the bladder contains urine, palpation will produce a desire to evacuate the organ and distress the patient to such an extent as to cause her to resist with her abdominal muscles. It is not sufficient that she has emptied her bladder just before coming to the physician's office, as a neurotic woman, awaiting her turn with anxiety and fearing to be told that she must undergo an operation, will secrete an astonishing quantity of pale, limpid urine in a very short time. If there is any doubt about the bladder being entirely empty, it should be catheterized as the first step of the examination. The rectum should also be empty and, if necessary, the patient may be instructed to take an enema before coming to the physician. The corset and all constricting waist bands must be removed before the patient is placed on the table.

The secret of a successful bimanual examination is to obtain the coöperation of the patient herself. She naturally is afraid of being hurt, and nature has provided a cuirass of armor in the abdominal muscles with which she may protect the delicate abdominal cavity from outward injury. If a quick motion is made toward the abdomen with the hand, the abdominal muscles are placed on guard instantly and almost involuntarily. In a woman with well-developed abdominal muscles, it is impossible to palpate the pelvic organs satisfactorily

if she chooses to resist. There are only 2 ways out of the difficulty—coöperation on the part of the patient, or anesthesia. With this fact in mind, the examiner will realize the necessity of gentleness and tact in order to gain the confidence and coöperation of his patient. The proper use of the hands will be considered in detail later.

It is generally accepted that it is useless to attempt a pelvic examination in young girls and the excessively neurotic without anesthesia, as little knowledge of value can be obtained, and severe and unnecessary mental shock is caused. Nitrous oxid is usually sufficient for this purpose. A nurse is very desirable, although not essential. The ready assistance and soothing influence of a trained woman assistant go far toward making the ordeal less trying to the patient, and she enables the physician to conduct his examination with much greater facility.

If a nurse is not available, a third party should be present, not only for the benefit of the patient but as a protection to the physician from the malicious charges which are by no means uncommon.

It is well to remember that a large proportion of gynecological patients are neurotic and that "pelvic sensitiveness" is an attribute of neurasthenia, otherwise the inexperienced will be led to attach undue importance to the general expression of pain on pelvic examination. In certain cases, as the late William Goodell aptly remarked, "the patient may be suffering from a 'sore brain' and not a 'sore womb.'"

History.—In making a diagnosis, a proper history is a necessary preface to the physical examination. In addition to the points common to all medical histories, certain facts in the life history of the patient peculiar to her sex, which may have an especial bearing upon the condition of the reproductive organs, should be carefully inquired into. The menstrual history must be thoroughly ascertained—the age at which the menses first appeared and became established; the type of the flow, whether regular or irregular in appearance, and the number of days of interval; the duration; the quantity (the number of napkins used each day is the best guide); the character, whether accompanied with clots or tissue, color and odor; whether there is associated pain, and, if so, its location, viz., uterine, ovarian, back, or general pelvic; the character of the pain—colicky, sharp, stabbing, aching, ovarian (which is the same as testicular pain), or soreness; the time of the pain in relation to the flow, which is important in such conditions as obstructive dysmenorrhea, when it may precede the appearance of the blood; the previous character of the menstruation; and, finally, menopause symptoms, if the patient has reached or passed that period.

It is well to remember, in judging the condition of the menstruation, that every woman is a law unto herself as to habit, but, this having been properly established, she should not markedly deviate from her rule. For instance, one

ABDOMINAL EXAMINATION		
Muscles.		
R. Kidney	I. Kidney	Liver
Gall Bladder	Spleen	
Stomach	Appendix	Hernia
Intestines	Neoplasms	
PELVIC EXAMINATION Ex. Genitals		
Clitoris	Urethra	Skene's Glands
Pelvic Floor	Bartholin's Glands	Anus
Rectum	Coccyx	
Vagina	Ant. Wall	Post. Wall
Cervix	Fornices	Parametria
Uterus		
R. Tube	I. Tube	
R. Ovary	I. Ovary	
Utero-Sacral Ligaments	Pelvic Cavity	
CYSTOSCOPY		
Urethra	Bladder	
Trigone	Fundus	
R. Ureter & Kidney	I. Ureter & Kidney	
POSTURE		
LABORATORY REPORTS: Urine		
Blood Pressure	Blood	
Smears		
Tissue		
DIAGNOSIS		
<div> <div>REFERRED</div> <div> <div>OPERATION</div> <div>TREATMENT</div> </div> </div>		
TERMS		

FIG. 1.—AUTHOR'S RECORD BLANK. Page 2.

MEDICATION AND TREATMENT
OPERATION AND DIAGNOSIS
POST-OPERATION

FIG. 1.—AUTHOR'S RECORD BLANK. Page 3.

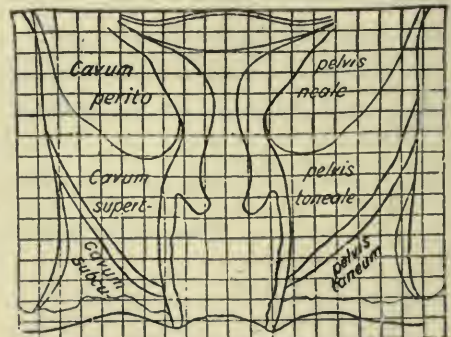
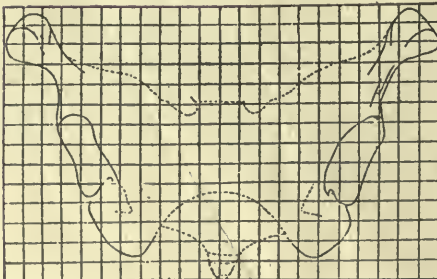
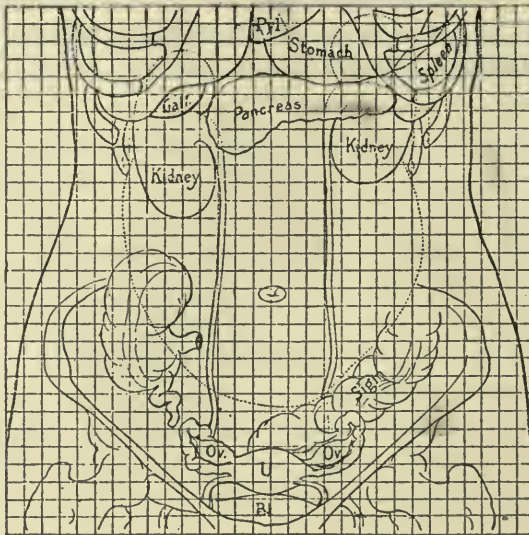
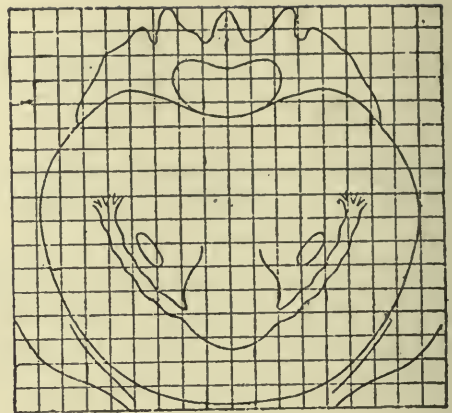
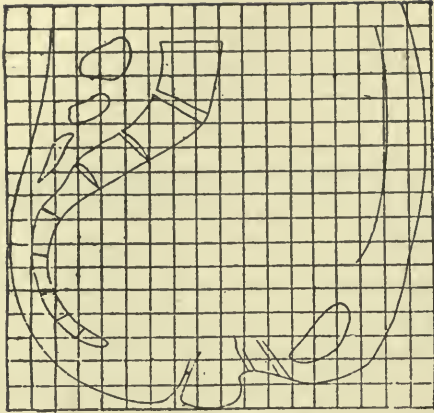


FIG. 1.—AUTHOR'S RECORD BLANK. Page 4.

woman will menstruate for 5 or 6 days, using 3 or 4 napkins during the height of the flow; while in another the function will last but 2 to 3 days and she will use only 2 or 3 napkins. Both may be perfectly normal menstruations, but if the second woman should flow as profusely as the first she might have an endometritis, and vice versa.

Two-thirds of all gynecological patients can trace their sufferings to something going wrong with the child-bearing function, a presumably normal phenomenon. Therefore, it is necessary to investigate carefully the character of all pregnancies—both labors and miscarriages. The dates of the labors, whether they were abnormal in any particular, the nature of any operative procedure—especially the use of forceps, and the duration and character of the puerperia should be ascertained. Likewise, the number of miscarriages—with the dates and the duration of the gestation—whether they were induced or spontaneous, whether the patient was cured, and the character of the convalescence, are all essential, as they may have a bearing on the diagnosis.

Pain, in some form or other, is the most frequent gynecological symptom and is usually the cause of the patient's seeking relief. The pain may be in the form of backache, pelvic tenesmus, headache or dyspareunia, or it may be referred to some particular part of the pelvis. Its character and location should be carefully studied.

Ovarian pain is similar to pain in the testicle and is peculiar in that it is accompanied with a feeling of nausea and faintness, or even shock, like that experienced from testicular trauma, for the ovary is normally as sensitive to pressure as the testicle. Tubal pain is characterized by tenderness and, if pronounced, is sharp, stabbing, and severe, as instanced in ectopic pregnancy. Uterine pain is of a colicky type if caused by any foreign substance, such as blood or a submucous fibroid invading the cavity, due to the efforts of this muscular organ to expel such contents; otherwise, a general tenderness and a feeling of weight may be complained of.

Any discharge from the vagina or external genitalia should be studied in its relation to other symptoms, and also its quantity and character should be noted. **It is a safe rule to regard every abnormal or persistent discharge with suspicion until its character is proved by a microscopical examination.**

Whether the function of micturition deviates from the normal should be inquired into. Symptoms referable to the urinary tract are practically always the same, namely, frequency, burning or smarting, and sometimes vesical spasm at the end of the act. Consequently, a diagnosis can only be made by the process of exclusion.

The condition of the bowels is a frequent cause of the pelvic congestion which is such a potent factor in gynecological pathology; therefore, the woman's habit in regard to this function may have an important bearing on her symptoms.

The details as to any previous operations should be asked for, and it may be necessary to interrogate the husband as to his freedom from specific diseases.

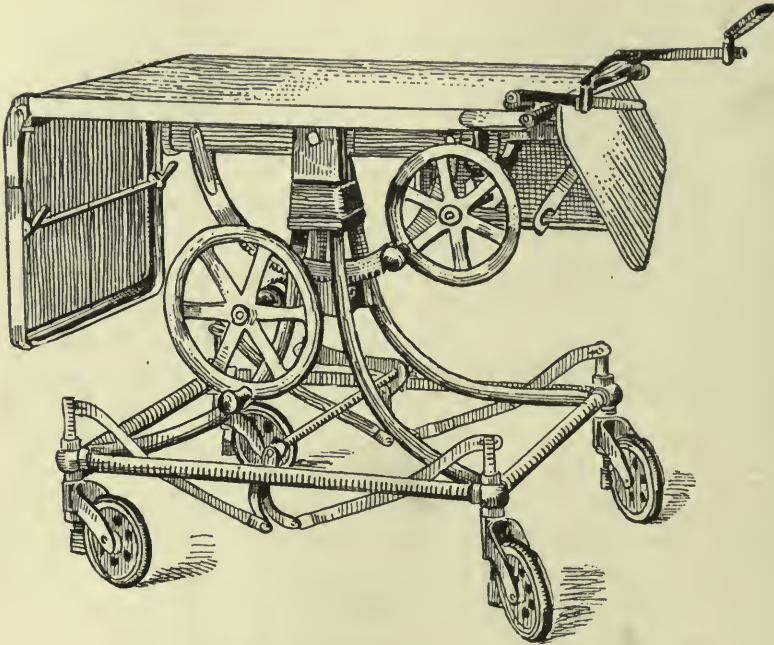


FIG. 2.—EXAMINING TABLE USED AT THE WOMAN'S HOSPITAL.

Finally, it is wise to make a summary of the present complaints of the patient, for ready guidance in studying the case and for future reference. Many

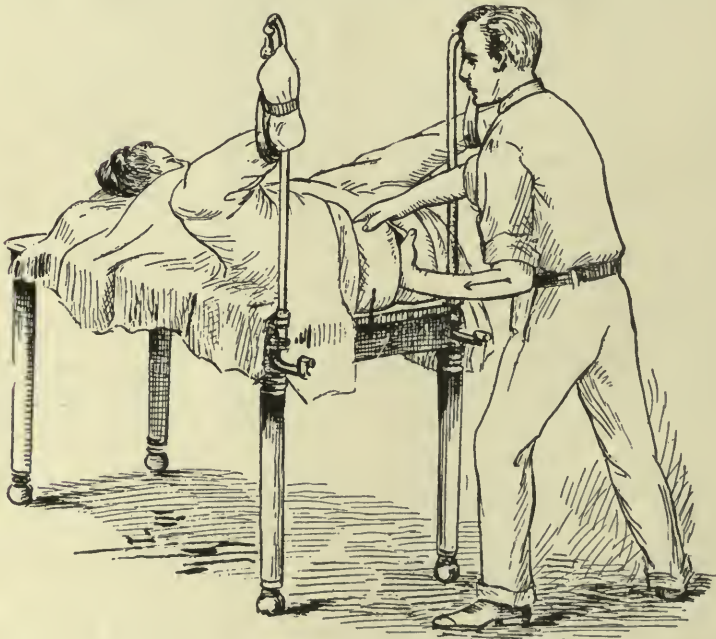


FIG. 3.—BIMANUAL EXAMINATION WITH PATIENT IN THE DORSAL POSITION.

forms of record blanks have been devised, in accordance with various tastes. Completeness, so that no important interrogation may be omitted, is desirable, and outline diagrams of the various pelvic planes and the abdomen, in which it is simple to note the size, situation, and shape of growths, displacements, etc., graphically are of especial value in recording gynecological cases. The record blank used by me is here shown (Fig. 1).

Examining Table.—A complicated table is not essential, but it is a distinct advantage to be able to tilt the table anteroposteriorly and laterally in certain

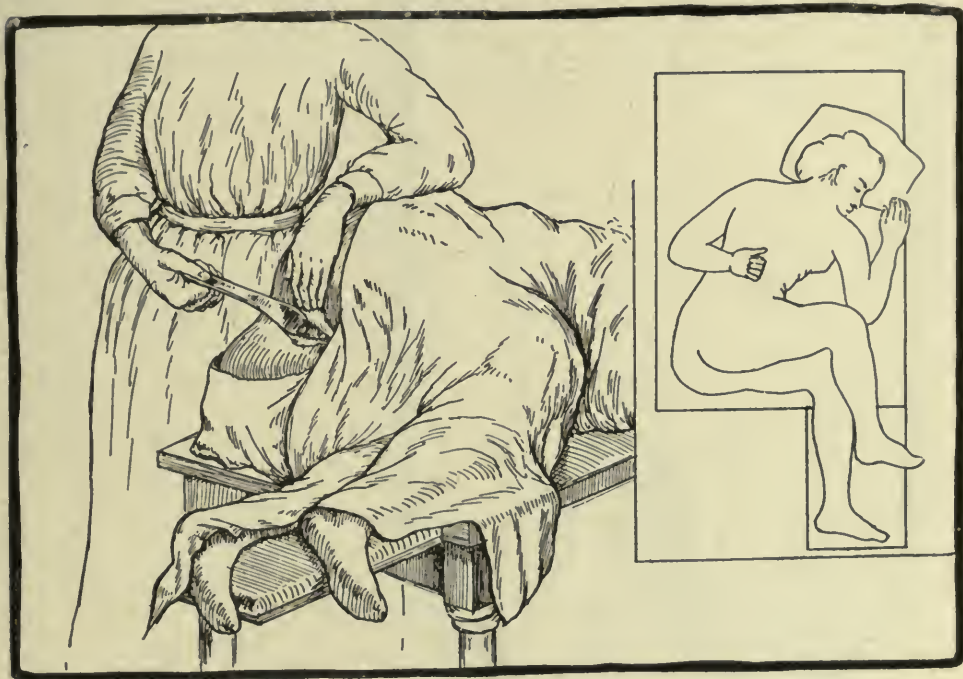


FIG. 4.—CORRECT POSITION OF THE NURSE WHEN A PATIENT IS IN SIMS' POSITION.

instances. The length of the table should be adjustable, and an oblique extension leaf at the foot is very useful and convenient when employing the Sims' posture. Edebohls' leg holders should be provided, in addition to the ordinary stirrups. Figure 2 shows a table used at the Woman's Hospital, designed to fulfill the above requirements.

Postures.—The usual postures employed during a gynecological examination are the horizontal recumbent, the dorsal, the lithotomy, the Sims', and the knee-chest postures.

The horizontal recumbent posture is used in examination of the abdomen. The clothing must be removed so that the body is exposed from the lower thorax to the symphysis pubis. The head and shoulders should be slightly raised.

The dorsal position is the one most used for the vaginal examination. The patient's buttocks should be brought to the extreme edge of the table, with the

feet placed in stirrups, which should not be widely separated, and the head and shoulders should be raised by elevating the upper half of the table or by pillows (Fig. 3).

The lithotomy position is the usual one employed for vaginal operations, and it is also very useful at times in examination. Edebohls' leg holders are inserted in place of the stirrups and the attachment of the patient's feet to the

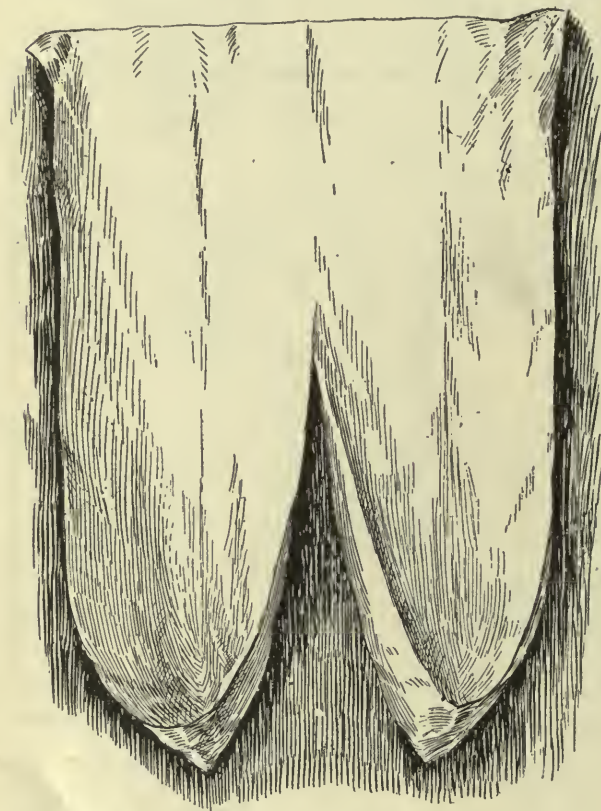


FIG. 5.—AUTHOR'S OFFICE SHEET.

rods causes the thighs to be flexed on the abdomen and rotated outward. This provides a more perfect relaxation of the abdominal muscles and also prevents the approximation of the patient's knees. In both the dorsal and the lithotomy positions, the head of the table may be lowered to an angle of 35° or 40° , in order to cause the intestines to gravitate away from the pelvis, with advantage during pelvic palpation.

The Sims' position is of great value, as the vault of the vagina and the anterior vaginal wall are well exposed, owing to the separation of the vaginal walls due to the partial vacuum in the pelvis caused by the gravitation of the intestines. The

cervix may be brought down in this position nearly to the vaginal outlet, thus facilitating exploration or the removal of a specimen. The correct position, as shown in the illustration (Fig. 4), is necessary to produce this result. It will be observed that the pelvis is considerably higher than the thorax and that it lies at an angle of 45° with the horizon, and is not perpendicular.

The knee-chest position is a still more perfect method of causing the vaginal walls to separate. Owing to the increased vacuum in the pelvis, the vagina is markedly ballooned. It is essential that the thighs should be perpendicular to the table, the chest must rest upon it as close as possible to the knees, and the back must be curved inward.

The patient's limbs should be properly draped so as to avoid unnecessary

exposure during the examination. A convenient form of office sheet for this purpose is shown in Figure 5.

THE EXAMINATION

The examination should consist of two parts; first, without instruments; and second, with instruments. While a diagnosis may be possible by the bimanual touch alone, an examination confined to this procedure cannot be considered thorough or complete. An inspection of the cervix and an exploration of the uterine cavity are indispensable in many cases if an accurate opinion of the condition present is to be given.

EXAMINATION OF THE ABDOMEN

The examination without instruments should commence with the abdomen. The encroachment of pelvic growths upon the abdominal cavity and the frequency with which pelvic disease is associated with general abdominal pathology make a study of the abdominal organs a necessary part of every gynecological examination. A thorough emptying of the bowels prior to examination is of great value.

Inspection.—With the patient in the horizontal recumbent position, a careful study of the contour of the abdomen should be made from the side of the patient, and also from the feet. The size, shape, symmetry, and any irregularities are to be observed. If a tumor is present, the effect of deep inspirations upon the abdominal walls should be noted. The walls glide over a nodular enlargement if no adhesions are present, and, as a rule, the position of a tumor of pelvic origin is not changed by respiratory movements. The skin of the abdomen should be studied for evidences of undue tension or relaxation, for disturbances in its circulation, and for the pigmentation in pregnancy.

Excessive fat in nulliparæ shows as an increased rotundity with creases and is characterized with more firmness than in multiparæ, who are apt to be flabby with the distention in the flanks.

Tympany causes a symmetrical enlargement, with the greatest prominence at the umbilicus.

Ascites gives the appearance of a flattened ovoid, with prominence in the flanks on account of gravity.

An ovoid distention in the lower abdomen, with smooth outlines, generally denotes a cystic growth or pregnancy. In parovarian cysts, the enlargement is uniform, while multilocular growths usually have a nodular appearance, due to a number of bosses.

Fibroids give 2 characteristic forms—the cannon-ball, due to a growth enlarging the uterus in a distinctly globular shape, and the irregular mass, due to multiple growths.

Percussion.—The tympanitic, the dull, and the flat notes of both deep and superficial percussion are valuable in demonstrating enlargement of the abdominal organs and to show the relations of the intestines to an abdominal growth, to detect ascitic fluid, and to differentiate between fluid and solid tumors. In differentiating ovarian or uterine growths from retroperitoneal tumors, a tympanitic note is usually observed over the latter.

Auscultation.—Auscultation will be chiefly of value in differentiating abdominal tumors from pregnancy. It is well to remember that a bruit is often heard in fibroid tumors. The movement of gas in the intestines and frictions in acute peritonitis may be studied.

Palpation.—Palpation is the most useful aid in the abdominal examination. The presence or absence of a neoplasm, the situation, shape, origin, consistency, tenderness, and mobility of a growth are determined by it.

Fat in the abdominal walls may be differentiated from a growth in the abdomen by grasping the mass between the hands and lifting it up and away from the abdominal contents.

Having located a tumor in the abdomen, its outlines should be studied, and an endeavor should be made to locate its origin and its relation to neighboring organs. The mobility will be dependent upon the nature of its origin, whether pedunculated or not, and the presence or absence of adhesions.

A study of the consistency will show the character of the growth, whether it is fluid, semisolid, or solid. It may be solid in one part and fluid in another, as shown by varying degrees of hardness or softness. A fluctuation wave should be sought for by lightly percussing one side of the tumor, while the other hand rests against it on the opposite side. A cyst with thick walls and containing thick fluid under tension is sometimes difficult to differentiate from an elastic solid growth.

Tenderness may indicate areas of local or general peritonitis, or an acute inflammatory process in the growth, the result of infection or a twisted pedicle.

PELVIC EXAMINATION WITHOUT INSTRUMENTS

The patient having been placed in the dorsal or lithotomy position, care is taken by the nurse **not** to cleanse the parts, as a study of any discharge that may be present is important.

The investigation of the pelvic organs should be conducted in anatomical order, from without inward, commencing with the external genitals, after which the vagina, cervix, uterus, ligaments, the adnexa, and finally the pelvic cavity are examined.

EXAMINATION OF THE EXTERNAL GENITALS

The external genitals are examined by inspection. This is a very necessary part of the examination and is too frequently omitted. The inspection is made

by gently separating the labia with the fingers of both hands and observing from above downward (Fig. 6). Commencing with the clitoris, the prepuce or hood is retracted so as to reveal any adhesions or retained concretions. These may be sufficient to produce considerable irritation and may lead to neurotic disturbances. The meatus urinarius is next examined for evidences of acute inflammation or discharge. The openings of Skene's glands are also to be carefully investigated, as they are frequently the site of a latent gonorrhea, which is easily overlooked. Outerbridge's cervix stem is of value for this purpose (Fig. 7). The presence or absence of a discharge in the urethra or in Skene's glands can best be determined by stripping the anterior vaginal wall with the palmar surface of the index finger (Fig. 8). The external meatus is also examined for urethral caruncle and prolapse of the urethral mucous membrane.

The ability of the patient to close her vaginal mouth properly should be studied, and prolapse of the anterior and posterior vaginal walls (cystocele and rectocele) looked for by observing the function of the pelvic floor muscles. This can best be studied by having the patient cough or bear down or strain as if at stool, while the labia are separated by the examiner's fingers, after which she should be directed to close the vaginal orifice by contracting the levator muscle. If necessary, this contraction may be stimulated by pricking the parts with a pin. The function of closing the vaginal orifice is similar to that of closing the mouth. In the mouth we have a transverse slit with a fixed upper jaw and a movable lower jaw, the mouth being closed by the lifting up of the inferior maxilla against the immovable superior maxilla by the action of the masseter

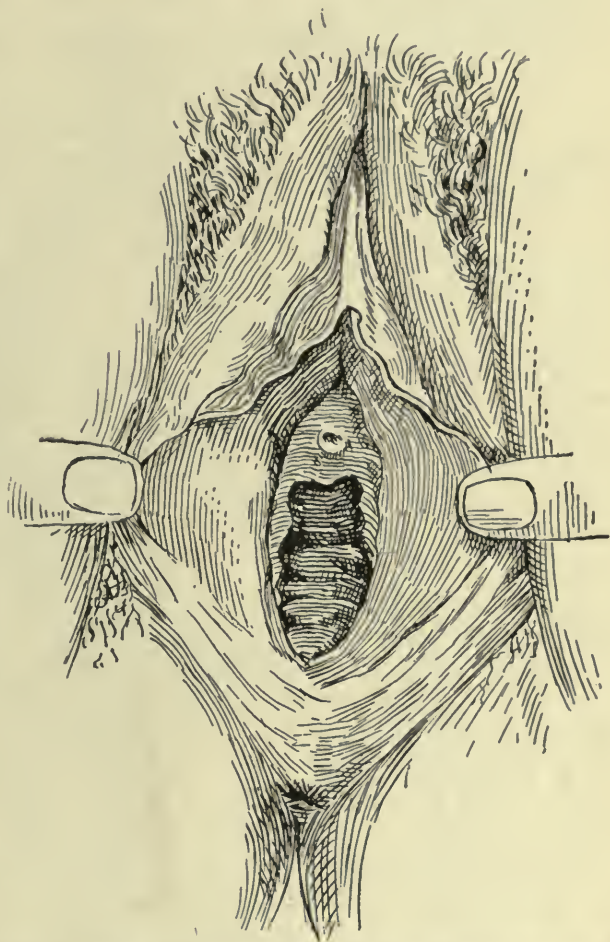


FIG. 6.—METHOD OF SEPARATING THE LABIA FOR INSPECTION OF THE EXTERNAL GENITALIA.

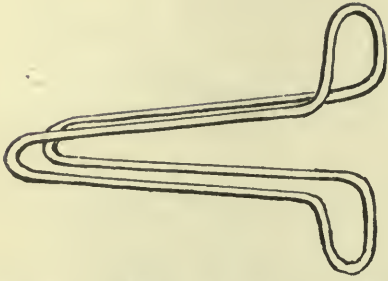


FIG. 7.—OUTERBRIDGE'S CERVIX STEM WHICH MAY BE USED AS A URETHRAL SPECULUM.

muscles. If these masseter muscles are cut or torn there results an inability to close the mouth, and the lower jaw hangs down. In the vaginal orifice, the conditions are similar. We have the transverse slit of the vagina, the fixed anterior vaginal wall, and the movable posterior segment of the pelvic floor. The orifice is closed by the lifting up of the posterior segment against the immovable anterior vagina by the action of the levator muscle, just as in the mouth, and not by a sphincter action, in spite of

the presence of a so-called sphincter vaginae muscle. The pelvic fascia gives support and strength to the levator muscle. In the vaginal sulci this may be

ruptured by the advancing fetal head, when it receives the brunt of the strain during the process of internal rotation in the mechanism of labor, or, as happens frequently, it may be torn, in both sulci, by the blades of the forceps. A condition is then produced similar to a rupture of the fascia lata of the thigh, when the strain in standing falls upon the quadriceps extensor, with resulting fatigue and ultimate stretching of that muscle. The torn pelvic fascia allows the strain to come upon the levator muscle, and consequently it ultimately becomes stretched and relaxed. The result is

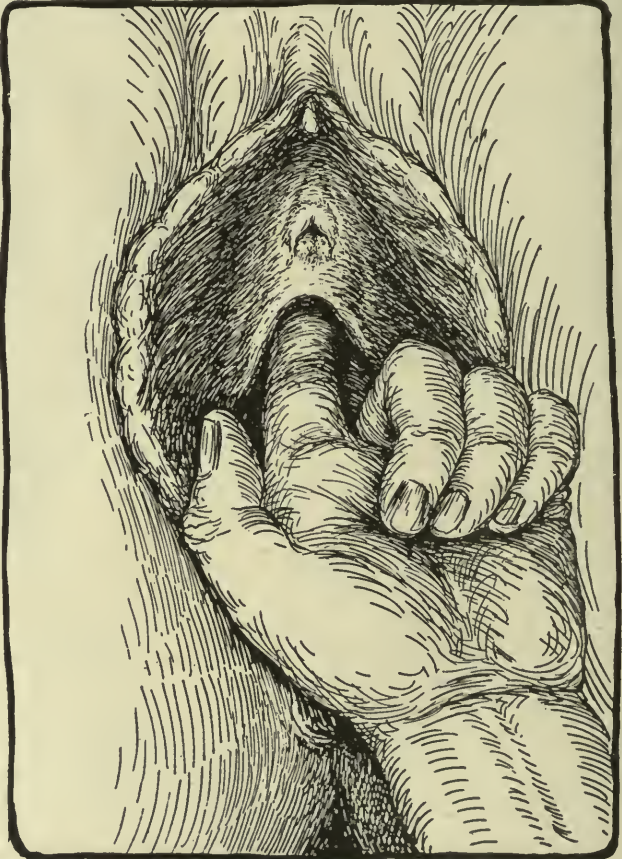


FIG. 8.—STRIPPING THE ANTERIOR VAGINAL WALL TO ASCERTAIN THE PRESENCE OR ABSENCE OF PUS IN SKEENE'S GLANDS.

that the posterior segment of the pelvic floor cannot be properly lifted up because of the elongated fibers of the levator muscle.

Any injury to the pelvic fascia and levator having been determined, the condition of the perineum itself should be looked to—whether median line tears or the extension of sulcus tears have been sufficient to impair the function of the sphincter ani or not.

A correct appreciation of the degree of vesical or rectal prolapse present in



FIG. 9.—PALPATION OF BARTHOLINI'S GLANDS.

a cystocele and rectocele can be obtained by introducing a sound into the bladder or a finger into the rectum.

The presence of varicose veins of the vulva shows obstruction to the return circulation, and may be indicative of a growth blocking the pelvis.

Bartholini's glands should always be examined for evidences of infection. Latent gonorrhea will be discovered, by the careful examiner, in these glands or their ducts in a surprising number of cases. The glands, which are the analogue of Cowper's glands in the male, are bean-shaped bodies and are some-

what deeply situated in the lower half of the labia majora. The openings of their ducts—which are 1 to 2 cm. in length—are situated on each side of the labia majora just below the center, and usually behind a tag or ear of the remains of the hymen. They are normally of the same color as the surrounding mucous membrane. Whenever these openings appear much darker in color than normal, or show irritation or lesion, suspicion should be aroused. The normal glands may be palpated quite easily between the thumb, externally, and the

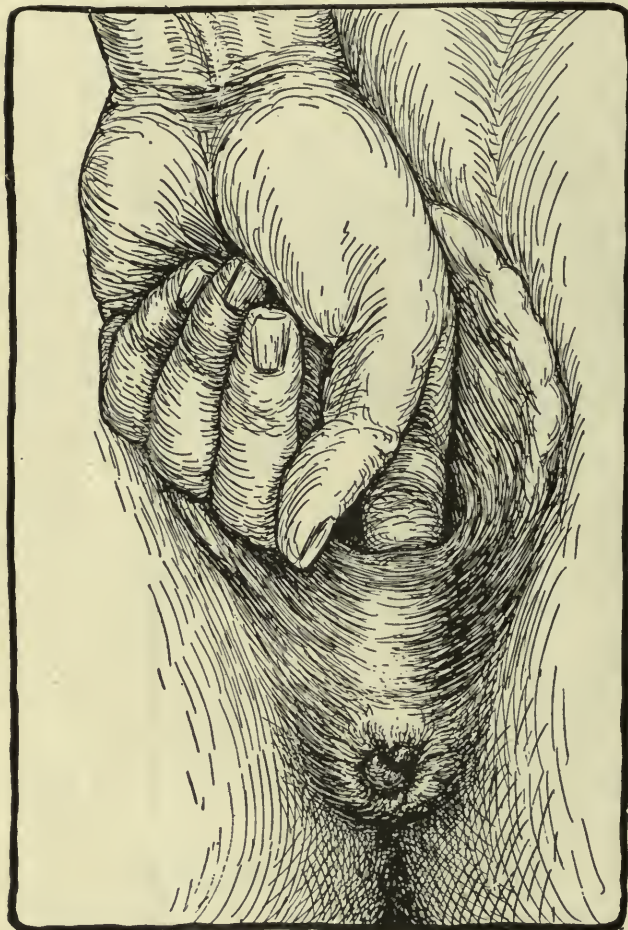


FIG. 10.—EVERSION OF THE RECTAL MUCOUS MEMBRANE BY PRES-
SURE OF A FINGER IN THE VAGINA.

rectal mucous membrane can easily be everted by a finger placed in the vagina (Fig. 10).

The presence of an acute vulvitis, condylomata, chancroids, venereal warts, etc., will be readily detected. It should always be borne in mind that an innocent wife is frequently a sufferer from diseases of this type through no fault of her own and in utter ignorance of their nature.

index finger in the vagina (Fig. 9). They feel about the size of a small bean as they are slipped between the finger tips and are normally not tender. The secretion expressed from them is a glairy, colorless fluid like the white of egg but if an infection exists, this secretion will be turbid or purulent, and a thorough search will usually discover gonococci. In such a case the gland itself can be felt as enlarged and tender.

Charles Norris has pointed out that a clear secretion expressed from these glands is not proof against the presence of the gonococcus.

The anus and rectum should be searched for hemorrhoids, fissure, fistula, etc. The

The coccyx is frequently the site of pain and inflammation—in its articulations—especially in neurotic women, and it should be palpated and its mobility and sensitiveness tested.

THE DIGITAL EXAMINATION OF THE PELVIC ORGANS

Palpation of the pelvic organs by touch, and especially by the bimanual method, where the object is to get the organs between the hands, so that their size, shape, consistency, mobility, and sensitiveness can be judged, and the presence in the pelvic cavity of neoplasms or inflammatory exudates determined, is our most efficient means of diagnosis. **A knowledge of the feel of the normal pelvic organs is essential as a standard of comparison.**

The Correct Use of the Hands.—The examiner should accustom himself to the use of the fingers of either hand in the vagina, as it is easier to reach the left appendage with the left hand and the right one with the right hand. As a rule, the examiner becomes accustomed to using but one hand in the vagina exclusively. The majority of gynecologists prefer to use the left hand in the vagina and the right hand on the abdomen, especially when they are right-handed. *This is the natural position, as the vaginal hand should be passive and the abdominal hand should be the active participant in the palpation.*

A most satisfactory lubricant is some form of liquid soap or some such preparation as lubrichondrin. Vaseline and other oily substances are not cleanly and are to be condemned.

The proper use of the hands is important in order to obtain satisfactory results. At first, it is best to use the index finger alone in the vagina. Care should be taken to avoid distress by unnecessarily touching the clitoris and urethra in the introduction of the fingers. This can be readily avoided by sweeping the knuckle of the flexed finger over the perineum from below until it slips into the vaginal orifice; then the finger is straightened over the perineum and into the vagina. It is important that the fingers should be held in such a manner as will insure deep penetration into the pelvic cavity. The hand must be rendered as narrow as possible to permit its passage between the ischial tuberosities, as then the whole pelvic floor can be pushed upward or invaginated into the pelvic outlet, thus greatly increasing the penetration of the examining fingers and rendering accessible to the touch parts which otherwise could not be reached.

The vaginal or passive hand with its forearm muscles should be in a state of relaxation. Two fingers in the vagina (the index and middle) will give the best results and should always be employed where the size of the entrance will admit them without injury. The thumb should be held straight up, and the ring and little fingers should be flexed at the **proximal phalangeophalangeal** joints, and **not** at the metacarpophalangeal articulations, as is usual. The reasons for this will be apparent if the illustration (Fig. 11) is consulted. A shows the ring and little fingers tightly flexed into the palm of the hand in the

usual way. The full length of the third phalanx of the ring finger and the head of the metacarpal bone are brought broadside or across the pubic arch, the ends impinging upon the tuber ischii and the rami of the arch, as in C, thus making deep penetration impossible, as bone rests against bone. B shows the correct position of the fingers. Note how narrow the hand is with the fingers in this position, allowing them to slip easily between the tuber ischii

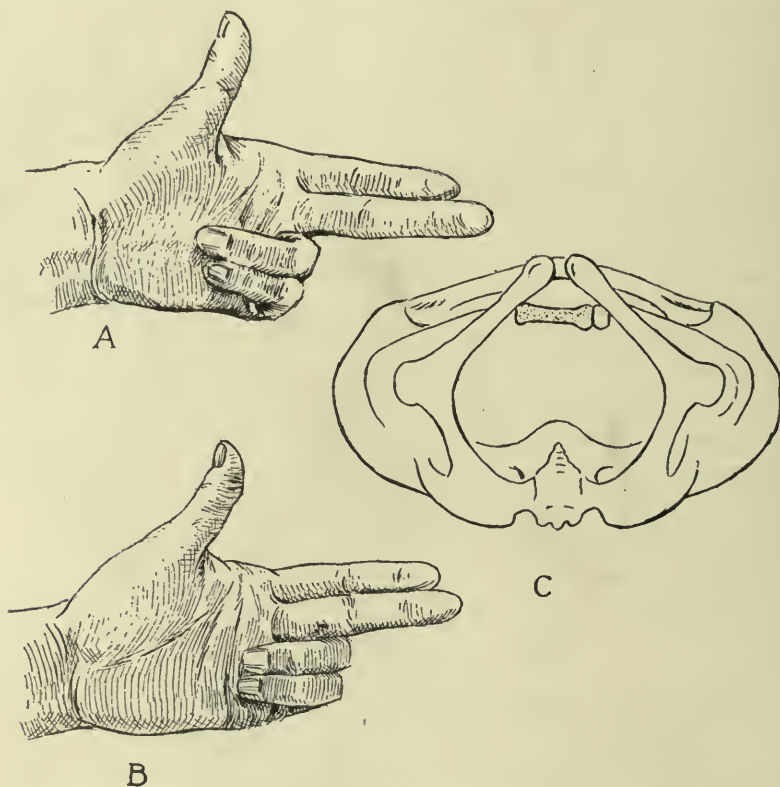


FIG. 11.—POSITION OF THE HANDS DURING INTERPELVIC EXAMINATION. A, incorrect flexion of the fingers. B, correct flexion of the fingers. C, Outlet of pelvis, with the third phalanx of the ring finger and across the pubic arch, as occurs with fingers held as in figure A, head of the metacarpal bone.

and to push ahead of them the soft and yielding pelvic floor structures, thus invaginating these soft tissues into the pelvic outlet. By this maneuver at least an inch can be added to the reach. The elbow of the examining hand should rest against the examiner's hip, and all pressure should be made by throwing the weight of the body upon the elbow, thus allowing the muscles of the forearm and arm to be at rest. The relaxation of these muscles facilitates the vaginal touch.

The correct management of the external or abdominal hand is of great importance. Too vigorous pressure is the rule with the novice, and it will promptly insure failure. The patient will resist to her utmost such rude in-

vation, by contracting her abdominal and pelvic muscles, instead of coöperating with the examiner by relaxing them. It is, therefore, necessary to bear in mind that more can be accomplished by gentleness of manipulation and tact than by physical force. When it is necessary to use deep pressure, it must be done slowly and gradually, so as not to alarm the patient. In diverting the patient's mind from the examination by asking questions and by getting her to keep the mouth open and to breathe in and out continuously, the desired entrance into the pelvis with the exploring hand may be gained at the moment of relaxation of the abdominal muscles. The 4 fingers of the external hand must be kept close together and slightly flexed. The palmar surface of the fingers should be used as much as possible. To separate the fingers and use the tips is decidedly unpleasant to the patient and will cause her to resist.

The Vagina.—When the fingers are in the vagina, its size, shape, capacity, sensitiveness, and the character of the mucous membrane are to be noted. The walls of the vagina may present a smooth, velvety feel, as when the normal rugæ are obliterated, as before involution is completed and in senile women, or it may feel hard and granular as in certain forms of vaginitis. Spasm of the vagina (vaginismus) may be observed as the fingers pass the introitus. The vaginal touch should convey a knowledge of the direction of the canal and the presence of cysts or growths in its walls.

The presence or absence of fecal matter in the rectum can be easily appreciated by the finger in the vagina. Scybulous masses can be indented or moved by pressure, and thus differentiated from tumors or exudate. In case of doubt, an enema will promptly clear up the diagnosis.

The Cervix.—When the fingers reach the cervix, the relation that it bears to the vaginal axis should be carefully noted. When the uterus is in its normal position with the bladder empty, its long axis is approximately at right angles to the long axis of the vagina, and the examining finger will touch the anterior wall of the cervix as it approaches it. If the uterus is retroverted into the hollow of the sacrum, its axis will be parallel or continuous with the vaginal axis, and the finger will directly enter the external os.

In cases of extreme retrodisplacement, the cervix will be found pointing upward toward the symphysis, and the entering finger will encounter the posterior cervical wall. It must be remembered that the position of the uterus is influenced by the amount of urine present in the bladder. A full bladder will displace the uterus so that the fundus points toward the promontory of the sacrum.

The condition of the cervix itself can readily be determined by the sense of touch. The number, extent, and location of lacerations, if any are present, should be noted. It is important, also, to determine the degree of patulence of the os, and whether any granular erosion or carcinomatous induration exists. The presence of dense scar tissue in the angles of lacerations should be felt for, and an effort should be made to ascertain whether there is any hyperplasia of the cervix or any cystic degeneration of the Nabothian glands. Cysts of the

glands of the cervix give the impression of the presence of buckshot under the mucous membrane.

The normal position of the cervix in the vagina is usually at a point corresponding to about the junction of the upper and middle thirds, and ordinarily it is not difficult to reach. In some cases, when there is a very deep vagina, or when the pelvic muscles are rigid and unyielding, it may be difficult to reach the cervix. It is a good plan to place the external hand gently upon the abdomen in commencing the examination; then, if the cervix cannot be readily reached, gentle pressure should be exerted in the direction of the axis of the pelvic inlet. This will depress the uterus and bring it within touch of the fingers in the vagina.

If the uterus is prolapsed, the cervix will naturally be found nearer the vulva than is normal. Care must be taken to differentiate a prolapsus of the uterus from a prolonged or hypertrophied cervix.

The Uterus.—After the examination of the cervix, as above described, the next step will be to examine the uterus as a whole. The knowledge obtained by the simple vaginal touch of the cervix must be further amplified by the bimanual touch, in order to arrive at a complete diagnosis of the position and condition of the uterus. It is obvious that if a flexion of the uterus exists, the position of the fundus, as indicated by the relation of the cervix to the vaginal axis, will be incorrect.

With the cervix resting upon the fingers in the vagina, slight upward pressure in the direction of the inlet of the pelvis is made, while the external hand makes gentle counter-pressure from above, gradually increasing until the fundus of the uterus is reached. This can be told by the fact that the pressure on the fundus is at once communicated to the fingers in the vagina, upon which rests the cervix (Fig. 12).

While holding the uterus in this manner, the size and shape of the organ can be judged and also the amount of mobility that it possesses. The uterus should normally give the impression of being suspended between elastic ligaments. It is movable forward or backward, upward or downward, in response to moderate pressure. On the pressure being removed, the organ should regain its normal position. In examining for the mobility of the uterus in this way, valuable knowledge can be gained as to the presence or absence of adhesions or of infiltration in the vaginal vault or broad ligaments, which causes various degrees of fixation of the uterus.

The size of the uterus can be judged after a little practice, as one soon learns the impression that the normal uterus conveys.

Any irregularity on the surface of the fundus uteri, such as might be caused by fibroids or malignant growths, may be determined by the external hand.

The contour of the normal uterus should be thoroughly mastered, so that deviations from it may be appreciated. If a normal uterus is held in the hand, the anterior surface can be readily distinguished from the posterior by the difference in contour. The anterior surface of the body is flattened, while the

posterior presents a well-rounded convexity which tapers in like a waist at the site of the internal os. There is a decided angle formed at the junction of the fundus with the anterior wall of the body (Fig. 13). These points can be brought out more surely if the fingers in the vagina are changed from under the cervix to the front of it in the anterior fornix, the external hand passed back of the fundus, and the uterus sharply anteverted over the vaginal fingers, which



FIG. 12.—THE PRESSURE ON THE FUNDUS OF THE UTERUS IS TRANSMITTED TO THE FINGERS TOUCHING THE CERVIX.

act as a fulcrum. If the vaginal fingers are then separated and alternately moved up and down, the uterus will be made to glide under the external hand so that its symmetry can be accurately appreciated (Fig. 14).

The various positions that the uterus may assume must be diagnosed by comparing the relation that the cervix bears to the vaginal axis and the position that the fundus occupies, as determined by the external hand.

If the cervix is at right angles to the vagina, and the external hand discovers the fundus about midway between the umbilicus and the symphysis, the position of the uterus is normal. Should the uterus be anteverted or ante-flexed, it would be necessary to explore with the external hand right up to and behind the symphysis, until the fundus is located. The position of the cervix

indicates whether the uterus is anteverted or anteflexed, and this may be further confirmed by slipping the vaginal fingers in front of the cervix, when, with the external hand on the fundus, any sulcus or bend in the organ is easily appreciated.

Three varieties of anteflexion may be recognized. The body of the uterus may be in its normal relation with the pelvis, while the cervix is bent so as to lie in the axis of the vagina, instead of at right angles to it. This is spoken of as anteflexion of the cervix. The opposite of this condition may exist, the cervix being in its proper position, while the body is bent forward upon the cervix. This variety is designated as anteflexion of the body, in contradistinction to the

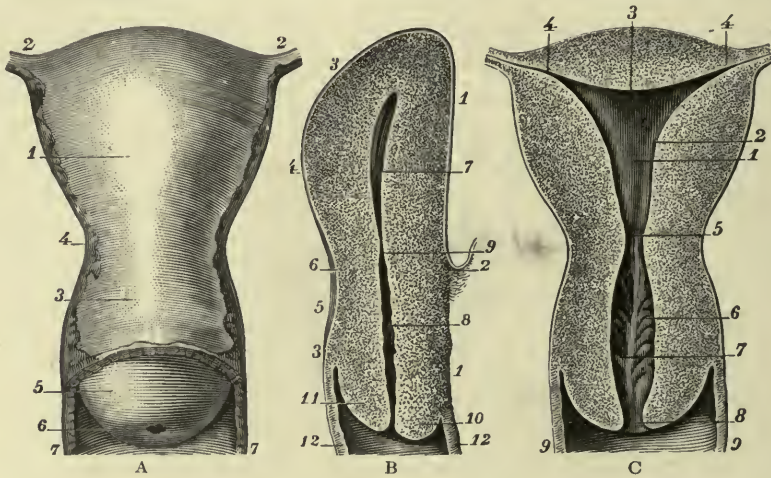


FIG. 13.—VIRGIN UTERUS. A, anterior view; B, median section; C, lateral section (Sappey). A, 1, body; 2, 2, angles; 3, cervix; 4, site of the os internum; 5, vaginal portion of the cervix; 6, external os; 7, 7, vagina. B, 1, 1, profile of the anterior surface; 2, vesico-uterine culdesac; 3, 3, profile of the posterior surface; 4, body; 5, neck; 6, isthmus; 7, cavity of the body; 8, cavity of the cervix; 9, os internum; 10, anterior lip of the os externum; 11, posterior lip; 12, 12, vagina. C, 1, cavity of the body; 2, lateral wall; 3, superior wall; 4, 4, cornua; 5, os internum; 6, cavity of the cervix; 7, arbor vitae of the cervix; 8, os externum; 9, 9, vagina. Note the flat anterior surface as compared to the well-runded convex posterior surface of the uterine body, also the triangular shape of its cavity as contrasted with the fusiform cavity of the cervix.

above. Then, again, the third variety may occur, in which both cervix and body are out of their normal positions, the flexion being very acute, and the cervix and the body closely approaching each other.

When the uterus is displaced or flexed backward, the search for the fundus is made toward the sacral promontory. It is apparent that if the fundus is at or below the level of the promontory, it will be found extremely difficult—unless there is unusual relaxation of the abdominal muscles, or unless a general anesthetic is employed—to get the uterus between the hands; indeed, in some cases it is impossible to accomplish this.

The fact that the fundus cannot be found and that the cervix points in the axis of the vagina is strong presumptive evidence that there is a backward displacement of the organ beyond the sacral promontory.

Retroversion is classified by most authors into 3 degrees: When the fundus points toward the sacral promontory, it is a retroversion of the first degree. If it points into the hollow of the sacrum, being practically continuous with the vaginal axis, it is the second degree. When the fundus is still lower, in the pelvis, and the cervix begins to point upward toward the symphysis, it is classified as the third degree.

In cases where it is impossible to reach the fundus with the external hand,



FIG. 14.—THE VAGINAL FINGERS ANTERIOR TO THE CERVIX ACT AS A FULCRUM TO ANTEVERT THE UTERUS IN AN EXAMINATION AS TO ITS SYMMETRY.

owing to its backward displacement, the difficulty may be overcome if the uterus is drawn down by a tenaculum or bullet forceps until the cervix is nearly at the site of the hymen. If the index finger is inserted into the rectum while the uterus is drawn down, it is frequently possible to palpate the body and fundus with great facility. Kelly's corrugated tenaculum is designed especially for this purpose, as it enables the examiner to hold the tenaculum firmly with

the external fingers of the lower hand, while the counter-pressure is made as usual with the upper hand on the abdomen. This method enables the examiner to reach the fundus with both hands (Fig. 15).

In all cases of retrodisplacement, it is important to determine whether or not the uterus is adherent, as the necessity for an operation may be dependent upon that condition. If the uterus is easily replaceable to its former position, it is reasonable evidence that it is not bound down by adhesions. Therefore,

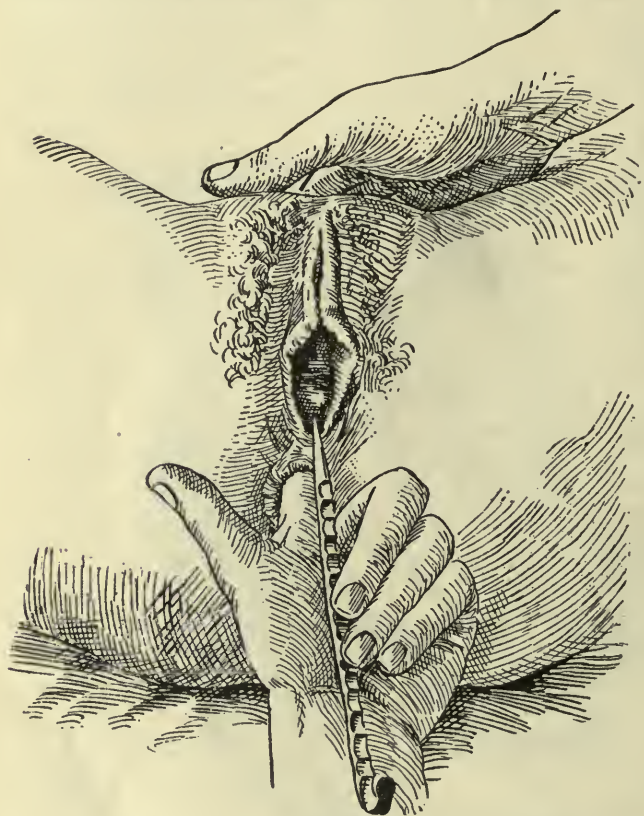


FIG. 15.—KELLY'S CORRUGATED TENACULUM IN USE.

the mobility of the uterus must be carefully studied. The employment of the knee-chest position is of the greatest value in determining the replaceability of the uterus, as a strong vacuum is produced in the pelvis in this posture, by reason of the intestines gravitating toward the diaphragm and, if the perineum is retracted with a speculum, the vagina will distend with air and the uterus, if moveable, will assume its normal relation, as the fundus will become dependent by gravity.

Retroflexion of the uterus can be dis-

tinguished from retroversion by the presence of a distinct sulcus or angle being felt at the junction of the cervix with the body. When a sulcus cannot be felt, and the fundus is out of reach of the finger in the posterior vaginal fornix, it is to be inferred that the uterus is not retroflexed.

The above method of drawing down the uterus will permit this point to be accurately determined, unless adhesions prevent, in which case the diagnosis must be left until it can be settled by the uterine sound or probe.

It is wise to confirm a diagnosis of flexion by the sound, as a subperitoneal fibroid on either the anterior or the posterior uterine wall will frequently be a cause of deception.

Lateral displacement of the uterus to the right or left of the median line

should be carefully noted. A uterus in such a position has either been drawn over to one side by the contraction of adhesions or it is pushed over by the presence of a cyst or growth filling the opposite side of the pelvis.

Normally, the pelvic organs, with the exception of the ovaries, are not sensitive to ordinary palpation. Deep pressure upon these organs will cause their characteristic pain. Tenderness of the uterus will generally indicate disease of that organ, as endometritis or metritis, although there is a certain class of patients whose organs, even when not appreciably diseased, manifest an abnormal degree of hyperesthesia. Pelvic sensitiveness is one of the prominent symptoms of an hysterical patient.

One of the most important items of information to be derived from the examination is the consistency of the uterus and the surrounding structures, as determined by the sense of touch. Each structure has its own standard, and the examiner must first become thoroughly familiar with the normal consistency before he can appreciate deviations which indicate pathological changes. The soft, friable condition of a carcinomatous cervix, the boggy impression conveyed by a subinvolted or edematous uterus, the hard plaster-of-Paris-like feel of the vaginal vault in pelvic peritonitis, the fluctuating sensation of a fluid tumor or abscess, are but a few of the conditions which must depend upon a comparison with the normal for their diagnosis.

The Uterine Ligaments.—After the examination of the uterus has been completed, the attention should next be directed to the ligaments which aid in its support. These ligaments are prone to inflammatory thickening, which may give rise to pain, and which frequently interferes with the normal mobility of the organs.

The anterior, posterior, and lateral fornices of the vagina are to be palpated in order to ascertain the condition of the uterovesical, uterosacral, and broad ligaments. Normally, the vaginal vault is elastic to the touch and should induration and thickening of the ligaments be present, these conditions can usually be made out by palpation.

The vaginal fornices must be explored for the presence of cysts, growths, prolapsed ovaries, collections of fluid, etc., which may occupy the culdesac of Douglas or the uterovesical space.

By comparing one lateral fornix with the other, as regards the ease with which the examining fingers may be moved in different directions, and also by comparing the 2 sides as regards the degree of pain elicited by pressure, one may obtain considerable information in regard to the pathological conditions that may be present.

The Adnexa.—The palpation of the adnexa has always presented difficulties to the inexpert. This is largely due to the lack of proper understanding of the difficulties to be dealt with.

In examining the ovaries and tubes, failure will frequently be attributed to the shortness of the phalanges, but if care is taken to follow the directions previously given, so as to insure an invagination of the pelvic floor into the

pelvic outlet, a sufficient penetration can be secured even with short fingers. The novice usually has no definite plan of procedure in mind other than to endeavor to catch the ovary between the finger-tips at the region he has seen it pictured in textbooks, at one side of the uterus near the plane of the fundus. In order to command success, there are 3 important factors in the problem that the examiner must thoroughly understand.

The first of these factors with which we must reckon is the abdominal muscles, as previously mentioned. These abdominal muscles form the armor which protects the abdominal viscera from injury, and when they are in a state of rigidity—as occurs almost instinctively, although they are under the control of the will, whenever the contents of the abdomen are in danger of trauma—they offer such a strong barrier that it is impossible for the examiner to palpate the underlying organs through them. Unless the patient's musculature has become so attenuated by poor physical condition and consequent emaciation, as often results from too frequent child-bearing or some wasting disease, one might as well attempt to palpate the pelvic structures through a wooden board as through the rigid recti. Overcoming this obstruction to success, then, is dependent on either coöperation on the part of the patient or anesthesia.

The second factor in the problem is to appreciate that the ovary and tube are movable. They have a considerable range of mobility, extending from behind the uterus in the median line of the body to the lateral wall of the pelvis. This can well be brought to the examiner's mind when he remembers how he has observed the surgeon bring up the appendage out of the true pelvis upon the abdomen of the patient through the abdominal incision.

The third factor is that these organs are extremely slippery bodies, being covered with and surrounded by peritoneum.

The observance of the preliminary preparation of the patient, previously mentioned, is very essential—the complete emptying of the bladder and the removal of all constricting clothing about the body. The directions already given to secure the coöperation of the patient in relaxing the abdominal muscles must also be carried out.

The first step is to locate the fundus of the uterus, as with the fundus for a guide the location of the appendages is made easier. This is done after the method previously described and shown in Figure 12.

Having located the cervix and the fundus of the uterus, the next step is to remember that the tube and ovary, unless bound down by adhesions, are **movable** and **slippery**, therefore the examiner must endeavor to **catch** these organs, and as they may lie or be pushed into any part of the space between the middle line of the body and the lateral pelvic wall, he must systematically search each half of the pelvis. To accomplish this, the vaginal fingers are next slipped to one side of the cervix into the lateral fornix, and deep penetration is made in a direction upward and backward at a point midway between the cervix and the pelvic wall. These fingers remain somewhat stationary, while

the 4 fingers of the external hand, curved in the shape of a scoop, rake the area from the fundus to the vaginal fingers. This maneuver will cause the slippery ovary to glide away from the uterus toward the lateral pelvic wall. This procedure is then repeated, as shown in Figure 16, commencing each time a little nearer to the side wall of the pelvis, thus driving the ovary still further outward, until finally, when it reaches the "end of its rope," as it were, it is caught between the examining fingers (Fig. 17). It may frequently be necessary to go over the ground repeatedly before the ovary can be caught, and the position of the vaginal fingers is to be varied from time to time, anteroposteriorly and laterally, so as to cover new planes.

As soon as the ovary and tube are imprisoned between the scoop formed by the external hand above and the fingers in the vagina below, their size, shape, sensibility, and consistency can be made out as they slip between the opposing finger tips. The normal ovary feels about the size of a walnut, and firm pressure gives to the patient the same sickening sensation and pain as does pressure of the testicle in the male. After the ovary has slipped through the fingers, the finger tips are still kept together and drawn upward, when the normal tube will be felt in the same way. Extending from the horn of the uterus, the tube feels like a cord, about the diameter of a slate pencil, and it is not painful to moderate pressure.

The opposite side of the pelvis is to be explored in a similar way for the other appendage.

In cases in which this method does not succeed, the examiner should resort to recto-abdominal palpation. In this method, the index finger is introduced into the rectum, instead of into the vagina, and the palpation is made with the opposing hand, as in the bimanual examination just described.

When the uterus is retroverted or retroflexed, recto-abdominal palpation is usually preferable and is a great gain, especially if the uterus is drawn down to the vaginal outlet by a tenaculum or volsellum, which permits the fundus to be reached posteriorly and brings the adnexæ within the radius of the examining finger. In women who are fat and who have rigid abdominal muscles, the expert must, in many cases, necessarily resort to complete anesthesia before he can make a positive diagnosis. A valuable aid, in difficult

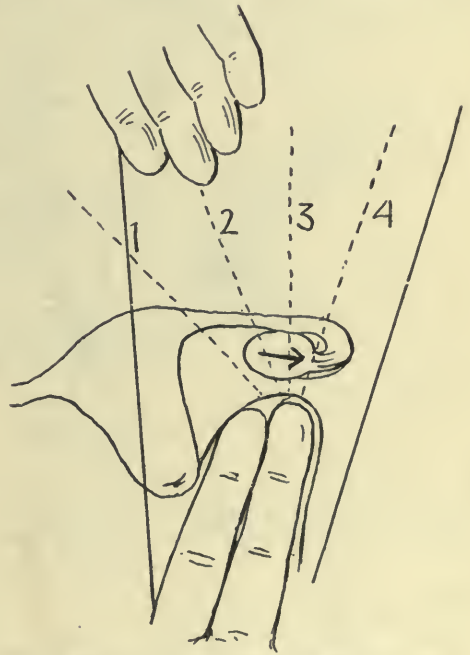


FIG. 16.—PALPATING THE OVARY.

cases, is to elevate the pelvis of the patient into a Trendelenburg posture for a few moments, to allow the intestines and omentum to gravitate out of the lower abdominal cavity, away from the examining hand.

Differential Diagnosis.—The differential diagnosis of the various pathological conditions that may be found about the uterus is to be next determined. In general, fluid accumulations or cystic growths that can be felt through the vaginal vault are diagnosed by the sense of fluctuation and elasticity.

If a mass is diffuse, boggy, ill defined, immovable, and tender, one suspects an inflammatory exudate. If a mass gives evidence of fluctuation, of increased heat, and of being very painful when pressed upon, while the patient at the same time gives a history of exposure to infection, of fever, and possibly of chills, the presence of an abscess is indicated. In inflammatory affections of the tubes and ovaries, these organs frequently are displaced into the culdesac

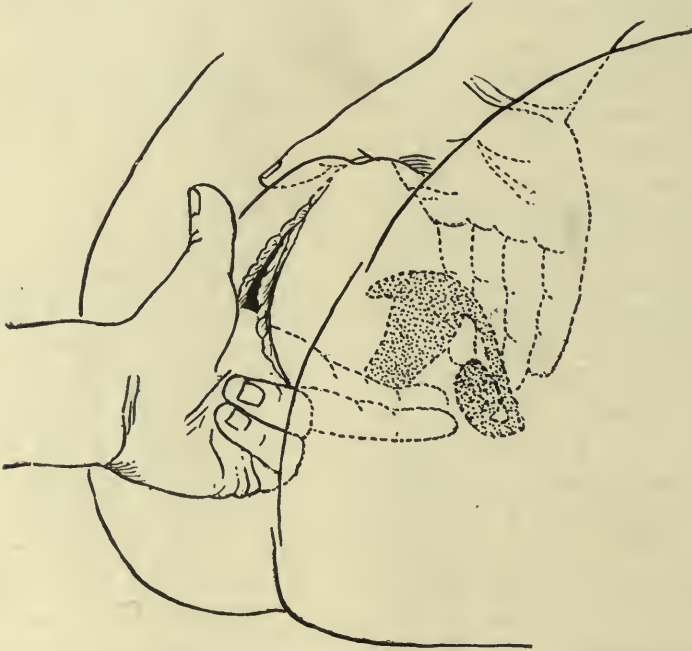


FIG. 17.—CATCHING THE OVARY BETWEEN THE TIPS OF THE EXAMINING FINGERS.

and fixed by adhesions. Generally a hydro- or pyosalpinx is of a sausage shape, and can be traced to the uterine cornua. Pregnancy, ascites, fat, gas, fecal accumulations, a distended bladder are but a few of the conditions that must be differentiated from tumors.

When the presence of a growth is certain, not only its character, but also its relations to the pelvic organs must be carefully studied. The presence of adhesions is judged by the amount of fixation that exists.

It should be borne in mind that acute inflammatory affections of the pelvic contents, appendicitis, and ectopic gestation should be carefully differentiated.

The ureters should be palpated at the base of the broad ligaments and along the side of the upper anterior vaginal wall for the presence of a calculus or thickening. The roots of the sacral nerves, as they emerge from the sacral foramina, should likewise be palpated for evidences of inflammation and as a source of pelvic pain (Fig. 18).

It is hardly necessary to say that experience will be required before it is possible for any one to acquire the *tactus eruditus* necessary to ascertain ac-

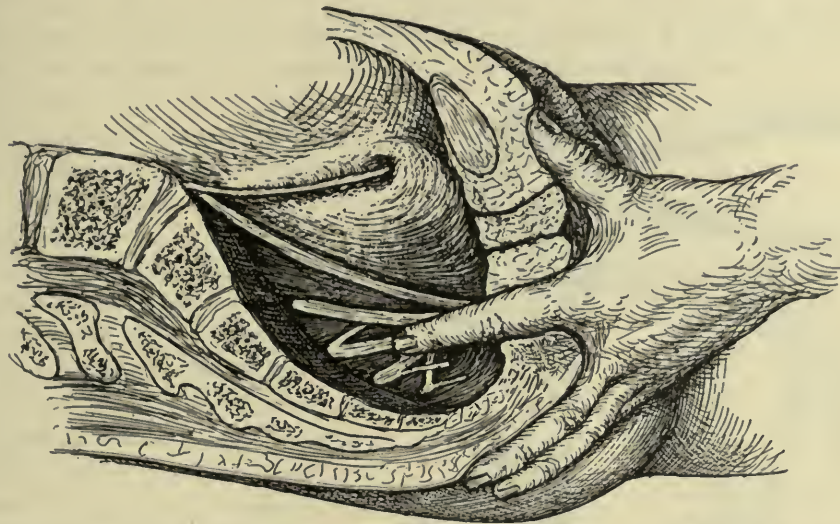


FIG. 18.—PALPATION OF THE ROOTS OF THE SACRAL NERVES AS THEY EMERGE FROM THE SACRAL FORAMINA.

curately by digital exploration the pathological conditions that are present in the pelvic cavity. The most expert gynecologists not infrequently see, on opening the abdomen, that their diagnosis was at fault.

No gynecological examination can be considered complete without a study of the mobility of the kidneys, stomach, and intestines—also the habitual posture that the patient assumes on standing. Displacements of pelvic organs are frequently but a part of a condition of general ptosis of the abdominal contents, and sacral backache may belong to the domain of the orthopedist.

The work of Reynolds and Lovett and of Dickinson in the study of the influence of posture on pelvic symptomatology are important contributions to the subject.

THE EXAMINATION OF THE PELVIC ORGANS WITH INSTRUMENTS

After the abdominal and bimanual examinations are completed, the instrumental examination is in order. The instruments necessary are: a bivalve speculum (2 sizes), a cylindrical speculum, Sims' speculum, long dressing forceps, single tenaculum, Kelly's corrugated tenaculum, double tenaculum or

bullet forceps, vaginal depressor, uterine probe, sound, a diagnostic curet, and a set of Hanks' dilators.

A sterilizer for boiling the instruments is a positive necessity for the protection of the patient from contamination. Immersing the instruments in a carbolic or other solution between examinations is not a safe method and cannot be too strongly condemned.

Suitable basins for cleansing solutions should be at hand, also glass slides, alcohol lamp, pipets, etc.—necessary for collection and preparation of dis-

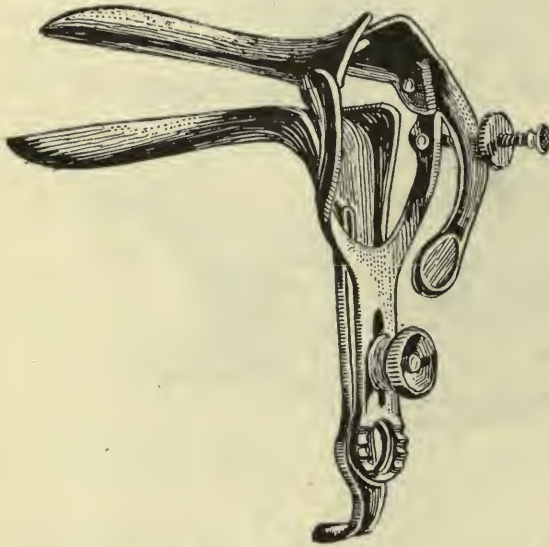


FIG. 19.—GRAVES' BIVALVE VAGINAL SPECULUM. Note that the anterior blade is shorter than the posterior.

charges for microscopical examination. Absorbent cotton made into cotton balls is very convenient and facilitates the cleansing of the vulva and cervix for inspection.

A convenient stand should be placed at the right hand of the examiner—as he sits at the foot of the table—upon which are arranged the instruments, tray of solutions, etc., within easy reach. A cold 1:1,000 solution of the oxycyanid of mercury, or one made with the convenient tablets of mercuric iodid combined with sodium bicarbonate and potassium iodid (after the formula of

McClintock), is most useful for immersing the instruments to cool them, after taking them from the sterilizer, as it does not corrode the metal and if freshly prepared is even more germicidal than bichlorid.

The Speculum.—The bivalve or trivalve speculum is the most popular type of instrument in use for exposure of the vaginal cavity and of the cervix, owing to the facility with which it may be used. This instrument suffices for an inspection of the cervix and vaginal vault, and for simple treatments, but if a more perfect and nearer view of the cervix and vaginal walls is necessary for the purpose of investigating the cavity of the uterus or of obtaining a specimen of suspicious tissue for laboratory examination, the Sims' instrument should be employed, because by no other method can such a satisfactory exposure of the vagina and cervix be made. The bivalve speculum gives a distant view of the cervix and affords but a limited amount of space in which instrumental manipulations may be carried out. If the uterus is in an anteflexed or anteverted position, it is sometimes difficult or impossible to pass a sound into the

uterus through this pattern of instrument. One of the best types of the bivalve speculum is that of Graves (Fig. 19). It has the advantage of being adjustable at the vaginal orifice and it can be converted into a Sims' instrument (Fig. 20).

The Sims' speculum is not generally employed, owing to the necessity of having a nurse or assistant to hold it, and the time and trouble necessary to change the position of the patient from the dorsal to the Sims' posture. The Sims' speculum alone does only a small part of the exposing of the vagina. It is in the Sims' posture that the great virtue of the method lies. In the correct Sims' position, the pelvis is tilted over at an angle of 45° , and is much higher than the upper half of the body, so that the intestines gravitate out of the pelvic brim as out of an inverted basin.

The patient is directed to lie on her left side, with the left arm flexed behind her back. Both knees are then to be drawn up in the direction of the chin, the uppermost knee lying above the under one. In this position, the sole of the right foot will come to lie above the left ankle. The nurse should then pass her left hand under the lower buttock until the crest of the ilium can be grasped. Traction should be made on the crest of the ilium until the lower buttock shall have been drawn to the edge of the table, while at the same time the right hand pushes the upper buttock in the opposite direction. This maneuver will tilt the pelvis so that the brim will lie at an angle of about 45° with the table. To prove that the pelvis is properly tilted, all that is necessary is to hold a straight rod at right angles to the table and against the lower buttock, when it will be seen that the upper buttock is 4 or 5 in. beyond its neighbor. The legs should lie on an extension leaf at the right-hand corner of the table, and the patient is covered with a sheet so that only the vulva is exposed (Fig. 4). The intestines will then gravitate out of the pelvis if the clothing has been previously loosened about the abdomen.

The nurse should stand on the examiner's left, facing him, and close to the side of the table. She should raise the upper buttock and labium with her left hand, keeping her fingers separated and extended, and taking care not to use their tips, but to roll up the buttock with the palmar surfaces of the fingers only.

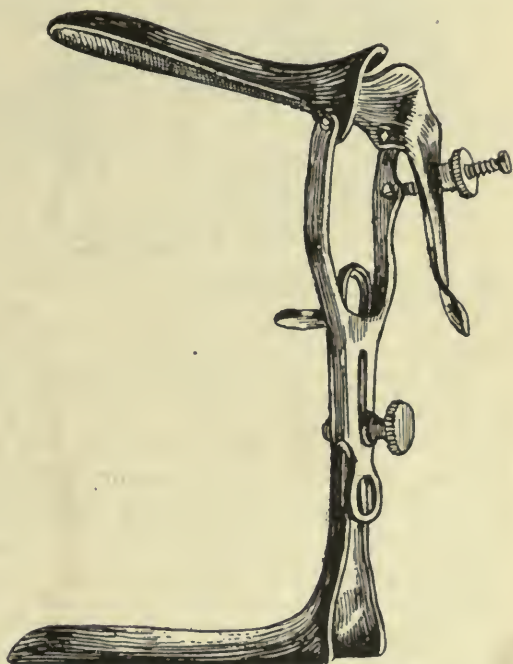


FIG. 20.—GRAVES' BIVALVE SPECULUM CONVERTED INTO A SIMS' SPECULUM.

It is decidedly unpleasant to the patient if the fingers are used as a claw. At the same time, the examiner draws down the lower buttock with his left hand in a similar manner, and holds one end of the Sims' speculum with his right hand, being careful to allow the index finger to project well beyond the tip of the blade, so that it may enter the vagina in advance of the instrument and act as a pilot to guide it behind the cervix (Fig. 21). In introducing the speculum, the direction of the axis of the vagina with the patient in the Sims' position must be borne in mind—the vagina runs in a direction toward the hollow of the sacrum. The projecting finger is made to enter the vagina, the speculum fol-

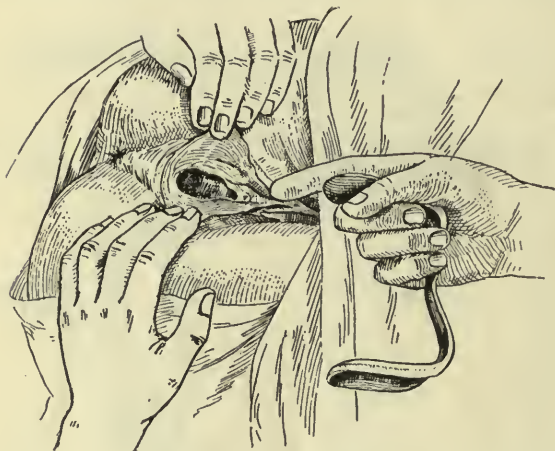


FIG. 21.—INTRODUCTION OF SIMS' SPECULUM. Note that the index finger precedes the blade in entering the vagina.

lowing after entering laterally, that is, the flat of the blade corresponds to the direction of the labial cleft. When the finger finds the cervix, the speculum can be easily guided behind it into the posterior vaginal fornix. It is then rotated to its final position, so that it will retract the perineum. The external end of the instrument is firmly grasped by the nurse, her fingers surrounding the blade, while her thumb lies in its groove.

The nurse's duties are to hold the speculum perfectly steady and to keep the upper buttock retracted. She can best do this with comfort to herself and satisfaction to the examiner if she stands straight up, facing slightly away from the physician, so that the arm holding the speculum is wrapped about her body. Her arm is thus steadied, and there is no occasion for any strain on the muscles of the hand or forearm (Fig. 4). If she is directed to increase the traction on the instrument, she simply rotates her whole body and does not bring into play the muscles of her arm. By this method, a nurse can hold a speculum for a long period without becoming tired, and it is far more satisfactory than stooping over the patient, grasping the speculum by the shank, and keeping up all the tension with the arm muscles, which soon tire and cause unsteadiness.

A vacuum being provided in the pelvis by the posture, when the speculum retracts the perineum and separates the labia, the air rushes in and balloons the vagina so that its folds are obliterated, thus permitting an unobstructed view of the entire vagina and cervix, except a portion of the posterior vaginal wall. In this position the uterus, unless fixed by adhesions, can be drawn down nearly to the orifice of the vagina, so that treatment or examination is greatly facilitated.

As the perineum is retracted and the vaginal walls are exposed to view, the cervix will usually be hidden behind the anterior wall of the vagina, which bulges in front of it with every deep inspiration of the patient, especially if a cystocele is present.

To obviate this, an instrument called a depressor is used to depress the anterior vaginal wall.



FIG. 22.—HUNTER'S VAGINAL DEPRESSOR.

The depressor is practically a spatula or spoon (Fig. 22), and should be held between the thumb and fingers of the left hand and gently used to push aside the bulging anterior wall, so that the cervix may be brought into view. Care should be taken, while using this instrument, that the wrist is dropped below the line of vision.

The Dressing Forceps.—

As soon as the cervix is brought into view, a dressing forceps holding a cotton ball is used to cleanse the cervix and vagina of any secretion present.

Bozeman's forceps is a suitable type of this instrument, as it is curved so as to keep the hand out of the line of vision (Fig. 23).



FIG. 23.—BOZEMAN'S DRESSING FORCEPS.

Inspection of the cervix and vagina will verify the diagnosis made by the vaginal touch. The condition

of the vaginal mucous membrane, the presence of fistulæ or growths, the extent of cervical lacerations, infection, erosion, and hyperplasia of the cervix are brought into view.



FIG. 24.—SINGLE HOOK TENACULUM.

The Tenaculum.—The cervix is seized by the anterior lip, so that it may be

drawn down for closer inspection and also for the purpose of steadying the organ while a sound or other instrument is being passed into the uterus. The single-hook tenaculum, as shown in Figure 24, is the style of instrument usually employed for this purpose. It should be hooked into the cervix through the os.



FIG. 25.—SKENE'S DOUBLE TENACULUM FOR GRASPING AND DRAWING DOWN THE CERVIX.

For the purposes of examination and treatment the double tenaculum has many advantages over the single instrument. No matter how expert the examiner may be, he cannot help making a number of punctures with the single instrument during the course of his manipulations. The single instrument can-

not be left on the cervix but must be held by one hand, so that if both hands are needed it must be removed and then afterward reapplied. It frequently tears through a friable cervix, causing at times a bothersome hemorrhage. All of these disadvantages can be avoided by using a double tenaculum, such as Skene's (Fig. 25), or the ordinary bullet forceps will answer. With the double tenaculum, 2 punctures only are made in the cervix, instead of half a dozen. The instrument is clamped on by means of the catch, so that no hand is required to



FIG. 26.—SIMPSON'S UTERINE SOUND.

hold it. It will of itself act as a depressor to keep back the bulging anterior wall. So long as it remains fastened to the cervix, the uterus will be under perfect control. Care should be used in drawing down the cervix, as this is a procedure that may do much harm and cause considerable pain if adhesions or inflammatory conditions exist. The bimanual examination should have previously disclosed any condition of immobility of the organ or any lack of elasticity of the ligaments. Unless the uterus can be drawn down easily, without force, the procedure should not be attempted.

The Probe, Sound and Applicator.—The cavity of the uterus is explored by means of the probe or the sound.

The probe is a very flexible piece of copper or silver wire, with an olive-

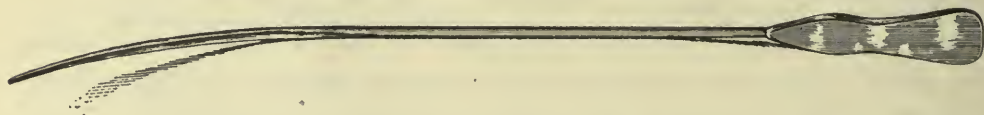


FIG. 27.—AUTHOR'S UTERINE APPLICATOR. Note the angular edges and the taper which facilitate the removal of the cotton after use of the applicator.

shaped tip of small caliber, and is designed for the exploration of a narrow or stenosed canal.

The sound is of a larger diameter, and is much stiffer than the probe, but is capable of being bent into any shape that may be required. Simpson's sound is the instrument usually employed (Fig. 26). It has a bulbous tip and at a point $2\frac{1}{2}$ in. from the end there is an enlargement which denotes the normal length of the uterine canal. The shaft is marked in inches for purposes of measurement.

The sound is an instrument capable of inflicting much damage, and requires great care in its use. Great harm may be done by employing it recklessly and unskillfully.

The applicator, cotton wound, is for use in applying solutions to the uterine mucosa (Fig. 27).

The first precaution to be taken before invading the uterine cavity is to ascertain the date of the last menstruation. If this precaution is omitted, the physician will frequently find that he has unintentionally interrupted a commencing pregnancy, sometimes to the delight of the patient, who may have had such an object in view in requesting examination for other trouble.

The instrument should never be introduced without having the cervix clearly in view, so that it may be passed directly into the canal of the cervix without coming in contact with the surrounding parts.

Any instrument that is to enter the uterus in the course of an examination should be sterilized, as if for an operation. Boiling is the safest method, but when the conveniences are not at hand the instrument may be immersed in a 95 per cent. carbolic acid for a few moments, and then in alcohol to neutralize the acid. The cervix should be painted with tincture of iodine. The bimanual examination will have

given the physician a fairly accurate idea as to the shape of the uterus and he

should shape his probe or sound accordingly. The instrument is to be held lightly between the thumb and forefinger and the cervix steadied by the tenaculum. When the instrument reaches the fundus, the forefinger is slid along the shaft until it comes in contact with the cervix. The probe or sound is then withdrawn, and the depth of the uterine canal and its direction can readily be noted.

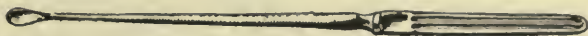


FIG. 28.—SKENE'S DIAGNOSTIC CURET.

The sound should not be used to determine the mobility of the uterus. The degree of mobility of the uterus can be determined better and more safely by the bimanual examination. The patency of the external and internal os, the position of the uterus, irregularities on the uterine mucosa, and the presence of growths in the cavity are ascertained by means of the sound. The sense of touch, as communicated through the sound, is here brought into play, and this necessitates that the instrument be held very lightly between the thumb and fingers, in order to appreciate any delicate variation. The use of the sound as a repositor is to be condemned. Any evidence of acute inflammation of the uterus or its appendages prohibits intra-uterine manipulations.

The Diagnostic Curet.—The curet is a diagnostic instrument of value in certain cases. The curet for this purpose should be small, so as to pass the internal os without difficulty. It should be dull and very flexible, so that no damage can be done with it. The spoon-shaped curet (Skene's), as shown in Figure 28, is especially adapted for diagnosis. The spoon curet enables one to scrape off shreds of tissue and epithelium from the endometrium, which should be examined under water to disclose their gross appearance, while they are to be submitted to microscopic examination for more accurate diagnosis. All that has been said in regard to employing the sound applies equally to the curet. The instrument must be properly sterilized and given the shape of the canal, which has been accurately ascertained by means of the sound or probe. It is to be

used with all gentleness. The curet is not to be used in the office to curet the uterus as for an operation; it should serve simply as a means of procuring a small amount of tissue or débris from the uterine canal for diagnosis only.

Dilatation of the Cervix.—This is a procedure which is sometimes necessary in order to admit the passage of an instrument or the examiner's finger into



FIG. 29.—HANK'S UTERINE DILATORS.

the uterine canal for purposes of diagnosis. It is frequently necessary to employ general anesthesia for its proper performance, as well as the usual preparations for a surgical operation, although a sufficient degree of dilatation may often be obtained without anesthesia by means of graduated dilators (Fig. 29).

PROCURING TISSUE AND DISCHARGES FOR MICROSCOPIC AND BACTERIOLOGIC EXAMINATION

Endometrial Tissue.—Endometrial tissue is procured for examination by curettage, and wherever there is suspicion of malignancy existing in the cavity of the uterus this operation should be resorted to. The scrapings may be collected by catching the washings in a piece of gauze held in the palm of the hand under a weighted speculum during the irrigation following the curettage (Fig. 30), or a glass may be used for the same purpose.

It is important to inform the pathologist at what period in the menstrual cycle the curetings were obtained, otherwise he may not be able to form a correct opinion as to whether they show pathological alterations or merely the physiological hypertrophic and atrophic changes that—since the work of Hitschmann and Adler—we now know normally occur preceding and following the time of the menstrual flow. Care should be taken to send all of the curetings obtained to the pathologist, as only a portion of them may show pathological findings. The tissues should be immediately placed in a 10 per cent. solution of formalin.

Excision of Tissue from the Cervix.—In all cases of suspicious ulceration or nodular induration of the cervix, and whenever an hypertrophied and irritated mucosa is present that does not yield readily to local treatment, a portion of the diseased tissue should be excised for examination by the pathologist. This procedure does not necessarily require an anesthetic, and may be done in the physician's office without great difficulty, and frequently without the patient's knowledge of the nature of the operation.

The easiest method of obtaining a piece of tissue from the cervix without

anesthesia is to place the patient in the Sims' position and, having procured a good exposure of the vaginal vault with the Sims' speculum, to catch the cervix with a double tenaculum or bullet forceps and draw it well down toward the vaginal outlet, within easy reach of the examiner. A few drops of novocain may be injected into the cervix at the site of the incision in cases where that organ is abnormally sensitive. The area is painted with tincture of iodine, and a wedge-shaped piece is excised with a sharp scalpel at right angles to the cervical canal, and made to include a portion of the cervical endometrium. A catgut suture may rarely be necessary to control bleeding. The excised tissue should

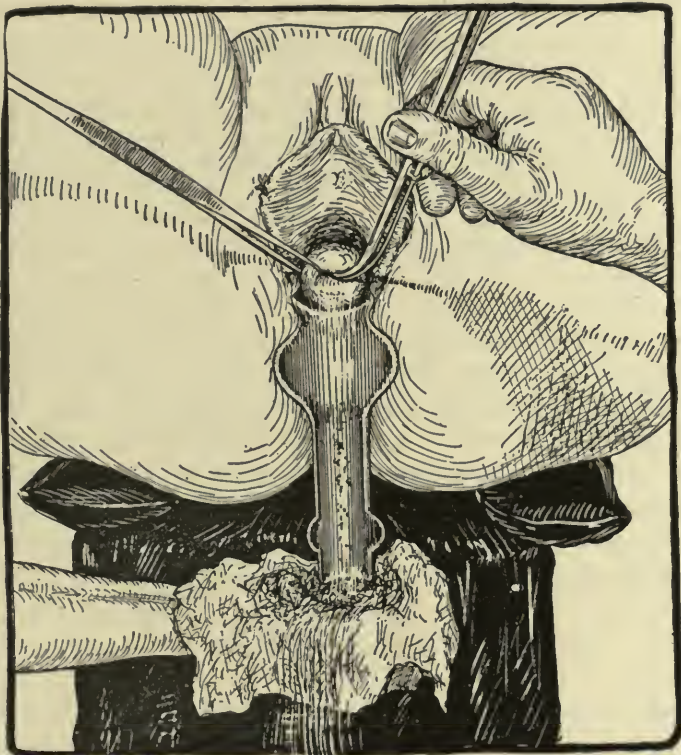


FIG. 30.—COLLECTING UTERINE CURETINGS FOR LABORATORY EXAMINATIONS.

at once be placed in 10 per cent. formalin and sent to the pathologist with a brief description of the history of the case and the site of removal.

Collecting Discharge for Microscopical Examination.—All abnormal discharges from any part of the genital tract should be examined microscopically, as a routine procedure. Great care should be taken in collecting and preparing smears, as a correct diagnosis may depend upon the observance of a proper technic, especially in cases of chronic or latent gonorrhea.

Glass slides should always be on hand, and may be kept ready for use in a 70 per cent. solution of alcohol.

Discharges may be collected and transferred to the slide by means of the

pipet, cotton swab, or the platinum loop. Van Gieson has shown that smears obtained with the cotton swab are not so reliable as when procured with the pipet or loop. One of the best instruments for collecting discharges from the external genitals is the ordinary medicine dropper, while one about 6 in. long is more convenient for use in the cervix.

If cultures are to be made, test tubes containing media and a platinum loop are necessary.

Smears should be made from the vulva, urethra, Skene's ducts, Bartholini's glands, and the cervical canal. At least 2 slides should be prepared from each locality, and each properly labeled.

The procuring of discharges from the female genitalia and demonstrating the gonococci in acute cases present no difficulties, but in the later chronic stages most careful, thorough, and repeated searches must be made before a positive opinion as to their absence can be given. Gonococci are most apt to be found immediately after the menstrual periods and during the early days following labor or miscarriage. Any local irritation of the mucosa sufficient to produce a slight exudate is often sufficient to bring out the gonococci. Thus, the dilating of the cervix and urethra with dilators, or the application of silver nitrate, will cause them to appear, the discharge being collected 24 hours later.

Discharge should be obtained from the urethra, Skene's ducts, and Bartholini's glands by the technic previously described. The cervix should be exposed through a speculum, and any thick, tenacious mucus present should be swabbed away with sterile cotton. It should then be steadied with a tenaculum and firmly compressed to squeeze out the secretion lying deep in the acini of the Nabothian glands. The familiar ring sponge forceps is a suitable instrument to squeeze the cervix with and the secretion should then be collected from well inside the canal.

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CHAPTER IX

TECHNIC IN OPERATIVE GYNECOLOGY

GEORGE GRAY WARD, JR.

Operative technic in gynecological surgery differs in no essential from that in surgery elsewhere, other than the adaptation of various measures to meet the peculiarities of pelvic pathology and the tissues of the female genitalia.

The tissues in this locality are abundantly supplied with blood-vessels and the process of repair is unusually rapid. Infection is ever a menace, owing to the proximity of the rectum and the fact that it is practically impossible to render the external genitals entirely sterile on account of the numerous folds, the delicate structure of the skin, and the abundance of the sweat-glands. Fortunately, however, these tissues have a considerable resistance to infection, as have those of the mouth and the rectum.

Time of Operation.—The preferable time for operations on the female genitalia is about midway between the menstrual periods. This will have given the patient sufficient time to have recovered from the last period and for the organs to be free from the congestion usual at that time. She will also have practically recovered from the effects of the operation by the time of the approach of the next period. In case of urgency, it is possible to operate in the abdominal cavity without any ill effects, even though the patient is menstruating. In patients who are flowing continuously, as in submucous fibroids or carcinoma, there is no choice as to the time of operation.

In certain cases of fibroids where there is an hysterectomy to be done, it is best to operate just preceding the flow, so that the patient may have had the maximum time since the last depletion in which to make up the loss of blood that she has suffered as the result of menorrhagia. In extensive plastic operations and in cases where an intra-uterine stem is inserted, it is better to have the time of operation as near as possible to the last period, for obvious reasons.

It is wise not to attempt to do plastic work on a case sooner than 6 months after pregnancy. Before that time has elapsed, the tissues are apt to be so soft and friable, owing to the incompleteness of the process of involution, that difficulty is experienced in making accurate denudations and approximations. Subinvolved tissues are like wet blotting paper in consistency, and frequently sutures will tear out with ordinary traction, and capillary bleeding will be excessive.

Gynecological patients are frequently neurasthenics, and prolonged waiting for an operation is apt to cause disastrous results to the nervous stability of the woman, on account of fear and apprehension. Therefore, as soon as an operation has been decided upon, the earliest time consistent with the nature of the case should be advised.

It is well for the surgeon to have a distinct understanding with the patient and her friends that he is to have a free hand to do what he considers for the best interests of the patient; otherwise, if his judgment is hampered by restrictions, the ultimate result will not infrequently prove unsatisfactory to all concerned.

Gynecological operations naturally are divided into two classes, vaginal operations and abdominal operations. Vaginal operations include plastic surgery and also pelvic surgery whenever the abdominal cavity is invaded from below. Abdominal operations include surgery of the pelvic organs and also associated complications of neighboring organs and tissues. A combined vaginal and abdominal operation is frequently necessary to cure the patient.

VAGINAL OPERATIONS

Plastic operations require skill and care to insure good results; therefore, time is essential and should never be sacrificed for speed in this type of surgery. The greatest care and accuracy should be employed in the denudation of tissues in order that exact coaptation of edges may be secured without undue tension. Sepsis is less apt to occur if care is taken to coapt edges accurately, as the avenues for the entrance of infection are thus lessened. A sense of symmetry is necessary, and the assistants must be taught to equalize tension in retracting tissues. It is well to outline all denudations with a scalpel as a preliminary step. In making a denudation or resection of tissue, it is always wise to err on the side of removing too little rather than too much.

Interrupted sutures are, as a rule, preferable to a continuous suture in this work, as they insure more accurate approximation of the parts. Care should be taken that the sutures are not tied too tightly, as a good result is often spoiled by strangulation of the tissues.

Preparation of the Hands of the Operator.—Rubber gloves are as essential for the safety of the patient in vaginal operations as elsewhere. After the usual thorough scrubbing of the hands under running hot water with liquid green soap, to which 10 per cent. of creolin has been added, followed by immersion in 70 per cent. alcohol, I believe that a valuable method is to dip the finger tips to the first joint in a finger-bowl containing a half-strength solution of the tincture of iodine—3.5 per cent. (Fig. 1). The finger-nails and the surrounding skin are probably the most dangerous harbingers of infection and this technic is efficient and not so harsh as the use of lime and soda. The hands are then again immersed in alcohol, dried with a sterile towel, powdered with talcum,

and the gloves are drawn on. Long sleeves are an essential to asepsis. The wrist bands are tucked under the gloves and held in place with rubber bands.

Preparation of the Patient for Vaginal Operation.—It is best for the patient to enter the hospital 48 hours before operation, if possible. It is necessary that there be sufficient time to make the usual laboratory investigations as to the blood, kidneys, discharges, etc. The heart and lungs should be carefully examined and the blood-pressure ascertained. A general bath should be taken and the patient be allowed a light and simple diet.

A vaginal douche of 1:5,000 bichlorid of mercury, followed by one of sterile water, should be given daily, and the alimentary canal should be thor-



FIG. 1.—IMMERSION OF THE FINGER TIPS IN $3\frac{1}{2}$ PER CENT. TINCTURE OF IODIN PRIOR TO OPERATION.

oughly emptied during this period. Castor oil, oz. i, given the day before the operation is probably one of the safest and most satisfactory drugs available for this purpose.

On the evening prior to the operation, the symphysis, vulva, and thighs are to be scrubbed with tincture of green soap and water, using a gauze sponge. The parts are then shaved and washed off with sterile water, followed by a 1:2,000 bichlorid solution. A vaginal douche of 1:5,000 bichlorid is then given, and the parts covered with a dry sterile pad of gauze. If the operation is not to take place until the afternoon, this preparation should be done early on the morning of the operation.

Early on the morning of the operation the lower bowel should be emptied with a soapsuds enema, which may be repeated until it comes away clear, if it does not exhaust the patient.

No food is given before the operation, unless it is to be performed in the afternoon, in which case coffee or broth should be allowed.

In cases of complete tear of the sphincter ani, the success of the operation may depend on a careful pre-operative preparation of the patient. For one week prior to the operation the bowels should be emptied with castor oil on alternate days, followed by copious flushing of the rectum. The diet for the last 2 days should be restricted to liquids. Vaginal douches of 1:5,000 bichlorid solution, followed by sterile water, should be given, and the external genitals, buttocks, and thighs thoroughly washed with soap and water each day. Urotropin, gr. vii ss, 3 times a day, for several days preceding operation, is indicated, if there is any evidence of colon bacillus in the urine, and as a precautionary measure in all operations involving the bladder or urethra.

In cases of complete procidentia, or when the cervix is markedly hypertrophied and congested, and when areas of ulceration are present, a 2-weeks treatment of depletion, puncturing all cysts with a bistoury, local applications of tincture of iodine and silver nitrate, and boroglycerid tampons, followed with daily hot douches and rest in bed, will reduce the congestion and render the tissues much more amenable to plastic surgery.

A half hour before the patient is taken to the operating room, a hypodermic of morphia, gr. 1/5, and atropin, gr. 1/150, should be administered. This has the effect of allaying the apprehension of the patient and insuring an easier anesthesia.

Posture.—Nearly all vaginal operations are most conveniently performed in the lithotomy position. In occasional cases, the Sims' posture is of advantage, as in certain types of vesicovaginal fistula.

Any standard operating table, with the Edebohls' leg-holders attached, is suitable. Care must be taken that the patient's buttocks are brought down slightly beyond the end of the table, so as not to interfere with the action of a perineal retractor.

The patient's legs are covered with long loose stockings, and her feet are fastened in the slings of the leg-holders, which are adjusted so that the thighs are flexed on the abdomen with the knees rotated outward and **outside** of the leg-holders. A Kelly perineal cushion is convenient and is placed under the buttocks with the flap hanging into a pail at the foot of the table for drainage.

The patient having been placed in the above position, the external genitals and the vagina are scrubbed with green soap and water. A piece of gauze is best suited for this purpose. Then the vagina and external genitals are flushed off with sterile water followed by a 1:2,000 bichlorid solution. The bladder should next be catheterized. The entire vagina and vulva are finally painted with half strength solution of tincture of iodine (3.5 per cent.).

Triangular-shaped sterile coverings are then placed over each flexed leg and leg-holder, and a sheet with 3 openings is placed over the patient. Each lateral opening goes over a leg, and the central opening, which is square, exposes the vulva (see Fig. 2).

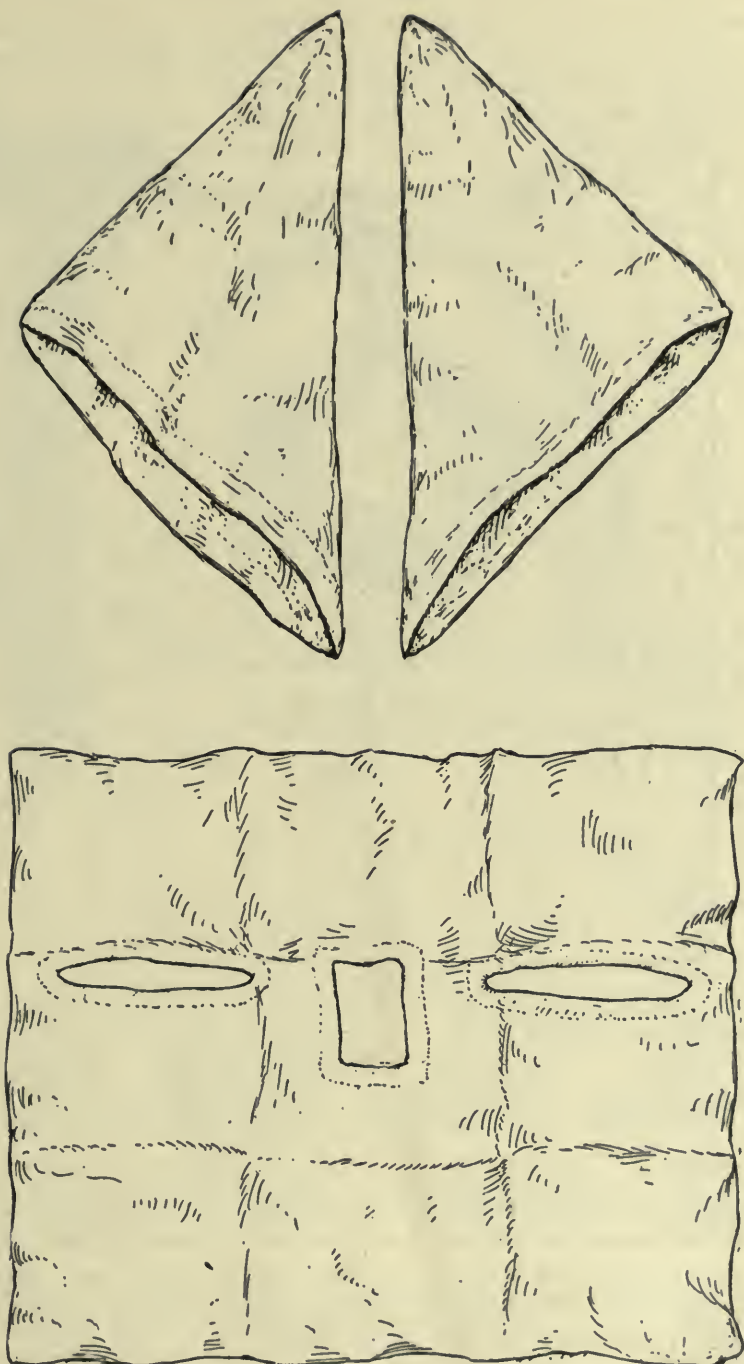


FIG. 2.—TRIANGULAR LEG COVERINGS AND SHEET WITH THREE OPENINGS USED IN VAGINAL OPERATIONS.

The labia minora are next drawn aside and sutured with a single stitch to the skin of the inner surface of the thighs. This is a simple and certain method of keeping the labia evenly retracted. The skin of the perineum midway between the anus and the fourchet is next sutured to the edge of a folded towel, the ends of which are

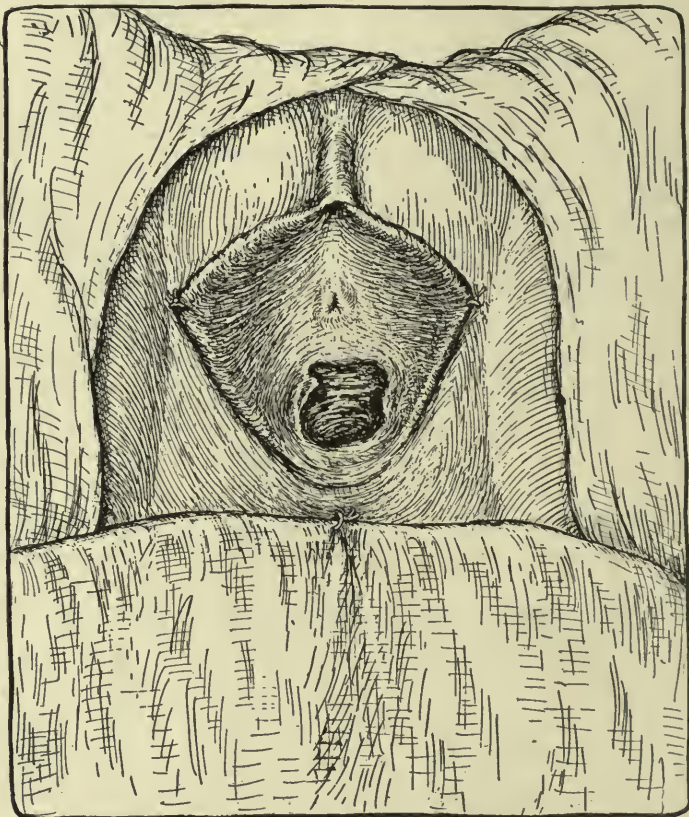


FIG. 3.—THE LABIA MINORA SUTURED TO THE SKIN OF THE INNER SURFACE OF THE THIGHS, AND A TOWEL OR EDGE OF THE STERILE SHEET SUTURED TO THE PERINEUM MIDWAY BETWEEN THE ANUS AND THE FOURCHET.

caught to the coverings with towel clamps. This effectively prevents contamination from the rectum, due to displacement of the coverings, and is a procedure of great value (Fig. 3).

Assistants.—Three assistants are necessary in addition to the anesthetist. One stands on each side of the patient to assist the operator by holding retractors, etc., and in sponging and one hands the instruments and sutures. The operator will find that a sterile tray placed close to his right hand, from which to help himself to instruments that he is constantly using, is a great convenience.

Control of Hemorrhage.—Many operators prefer to have a continuous stream of water directed over the field of operation to keep it clear of blood, instead of sponging. As a rule, the bleeding in plastic operations on the vaginal tissues is capillary and not severe. Occasionally a spurting artery may have to be

clamped and ligated. Venous bleeding may sometimes be sufficiently troublesome to require a suture ligature.

Instruments.—Certain instruments that are especially useful in vaginal operations are as follows:

A weighted speculum to retract the perineum is more satisfactory than the ordinary perineal retractor, which requires an assistant to hold it (Fig. 4).

Jacobs' forceps for grasping the cervix are far more satisfactory than the bullet forceps, as they hold more surely and do not tear out of a friable tissue so readily. Two pairs should be at hand (Fig. 5).

Ribbon retractors, made of malleable metal that can be bent into any required shape and length, are most useful for vaginal work (Fig. 6).



FIG. 4.—AUVARD'S WEIGHTED SPECULUM WHICH RETRACTS THE PERINEUM WITHOUT THE AID OF AN ASSISTANT.



FIG. 5.—JACOBS' FORCEPS.

The scissors illustrated in Figure 7 are modeled after Emmet's universal scissors. They are considerably heavier than the Emmet instrument and are very useful in denuding tissues of the vagina or cervix or in making either an



FIG. 6.—OCHSNER-MAYO RIBBON RETRACTORS. These may be bent to fit any surface. The smaller sizes make excellent vaginal retractors.

anterior or a posterior vaginal section. The right and left angular scissors of Emmet are not necessary for denudation if these scissors are available.

The scissors illustrated in Figure 8 are especially useful in flap-splitting operations.

The Hegar needle-holder shown in Figure 9 has been most satisfactory in



FIG. 7.—WARD'S UNIVERSAL SCISSORS.

my hands, especially if used with needles that have a flattened shank so that they will not turn over while in the grasp of the needle-holder. Schroeder's needles are a good example of this type. Curved needles are most generally



FIG. 8.—FLAP-SPLITTING SCISSORS.

useful, and should be of 2 kinds—trocar and round-pointed—and of 3 sizes. The trocar-pointed needles are most suitable for suturing the cervix and

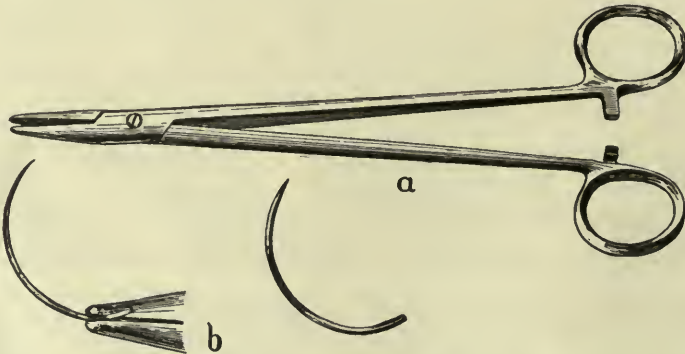


FIG. 9.—HEGAR'S NEEDLE-HOLDER AND SCHROEDER'S NEEDLES WITH FLATTENED SHANK. They cannot turn over while in the grasp of the needle-holder.

vaginal walls, while the round-pointed needles are best used in soft and vascular tissues, as in the uterus, broad ligaments, bladder, etc., as they are less likely to cause troublesome bleeding.

Mouse-tooth thumb forceps, with a broad bite of at least 4 teeth, are necessary for picking up tissues to be denuded or excised. It is a much more satis-

factory instrument for this purpose than the single tenaculum which was formerly so much used.



FIG. 10.—WARD'S MUSCLE FORCEPS. These are for grasping and drawing out the anterior portion of the levator muscles in repair of laceration of the pelvic floor.

Short bullet forceps are satisfactory for holding the labia majora; and Allis clamps, which have 5 teeth, are also useful for grasping delicate tissue. Short

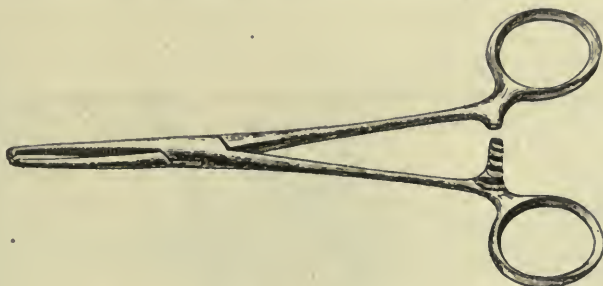


FIG. 11.—OCHSNER-MAYO STRAIGHT CLAMPS.

sponge holders are of assistance in grasping and bringing out the edge of the levator muscles in repair of lacerations of the pelvic floor (Fig. 10).



FIG. 12.—KELLY'S SMALL-POINTED ARTERY CLAMPS.

Straight Ochsner-Mayo artery clamps and Kelly small-pointed artery clamps are very adaptable for vaginal work (Figs. 11, 12).

Scalpels for outlining denudations, or for work on the cervix, should be shaped like the instrument shown in Figure 13.

A very useful instrument for delivering the fundus of a retroverted uterus

out of an ordinary colpotomy incision is that shown in Figure 14. A pair of these "cat's-claw" tenacula are used to climb up the anterior surface of the



FIG. 13.—SCALPEL FOR DENUATION OF CERVIX. Note the angle of the distal edge.

uterus and to deliver the fundus (Fig. 15). I have modified the original model by extending the flat guard well beyond the claws and enlarging it. The guard



FIG. 14.—WARD'S CAT'S-CLAW TENACULUM. This is used in anteverting uterus through anterior colpotomy incision, with guard to protect and elevate the bladder.

is used to lift away the bladder from the face of the uterus and to prevent its folds from becoming caught in the claws.

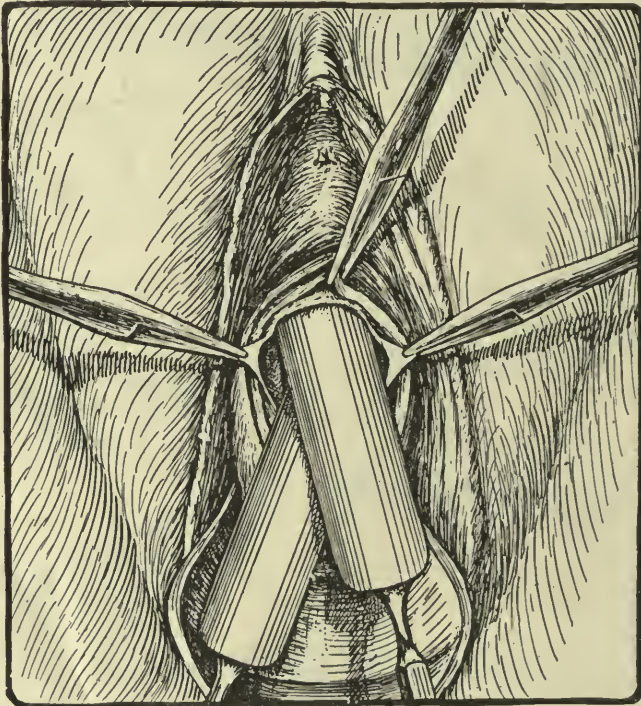


FIG. 15.—WARD'S CAT'S-CLAW TENACULA IN USE IN DELIVERING THE FUNDUS OF A RETROVERTED UTERUS THROUGH AN ANTERIOR COLPOTOMY INCISION. Two tenacula are used alternately to climb up the anterior surface of the uterus.

A useful forceps, devised by me for removing the retained ovum or its membranes in an abortion, is shown in Figure 16. One ring of this instrument is

slightly smaller than the other, so that it fits into it in such a manner as to throw any tissue into a fold or kink. It thus grips slippery tissues securely.

Light and heavy uterine dilators of the familiar Goodell model are necessary; also several sizes of Sims' sharp curets, both plain and of the irrigating type.

An intra-uterine irrigator that will maintain a dilation of the cervical canal, so as to allow a free flushing of the uterine cavity, is essential.

A good electric cautery with assorted tips is desirable. The Percy electric cautery is an excellent model.

Suture Material.—Plain and chromicized catgut and silkworm-gut are the most useful suture materials for vaginal operations. Chromic catgut, Nos. 1 and 2, is the most suitable for suturing vaginal and uterine tissue. Silkworm-gut is best for external perineal sutures. Fine silk or Pagenstecher linen is needed for suturing the rectal mucous membrane in cases of complete tear of the

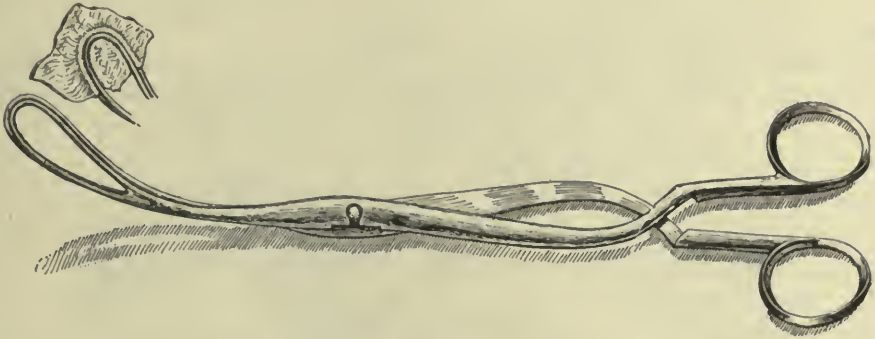


FIG. 16.—WARD'S ABORTION FORCEPS. Note one blade fits within the other so as to throw the tissue grasped into a kink, thus insuring a firm hold.

sphincter ani. Silver wire is not much used today, except in certain cases of vesicovaginal fistula.

Procuring of Uterine Scrapings for Pathological Examination.—Uterine curetings should be sent to the laboratory for examination in all cases, as a routine procedure. Care should be taken to procure all of the curetings, as only a portion may show important changes.

A simple method of collecting scrapings is for the assistant to hold a gauze pad in the hollow of his hand at the end of the weighted speculum. When the uterus is flushed out by the irrigation, the debris will be washed out of the uterus and the vagina down the groove of the speculum into the gauze. The gauze pad with the scrapings should then be transferred into a wide-mouthed bottle containing a 10 per cent. formalin solution. Care must be exercised not to squeeze the pad, or the structure of the endometrial tissue may be altered (Fig. 30, Chapter VIII, Volume V). A small glass instead of the pad of gauze may be used to catch the material. Another method is to place a table-spoon under the mouth of the cervix.

It is important that the pathologist should be informed of the relation of the time of the curettement to the menstrual period.

Technic of Denudation.—By denudation is meant the removal of the vaginal mucous membrane and the tissues of the external genitalia, in the performance of plastic operations, in order that the cut surface may be approximated by sutures. It is important that the area to be denuded should be carefully outlined with a scalpel before removing the tissue.

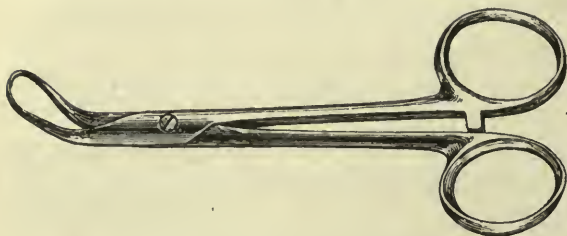


FIG. 17.—BULLET FORCEPS. These are used in grasping the tissue to be outlined in the repair of laceration of the pelvic floor.

(Fig. 17) or Allis clamps and put on the stretch. This will enable the operator to mark the outline of his denudation more perfectly than if he attempts to do so with the mucosa in loose folds.

The area of denudation having been marked out, the tissue to be removed is picked up with a broad mouse-tooth thumb forceps and, with the universal scissors, or Emmet's angular scissors, the tissue is removed in successive strips (Fig. 18). Care should be taken not to leave isolated pieces of mucosa or skin, as they will interfere with a proper union.

In denuding the lips of the cervix in repair of that organ, a sharp scalpel is preferable to the scissors for removing the tissue.

The assistants should endeavor to keep the parts retracted evenly and to keep the field of operation ahead of the scissors clear of blood.

Technic of Flap-Splitting.—By flap-splitting is meant the method of freeing the vaginal wall by finding the line of cleavage between the vagina and the

performance of plastic operations, in order that the cut surface may be approximated by sutures. It is important that the area to be denuded should be carefully outlined with a scalpel before removing the tissue. The most prominent parts of the tissue should be grasped with bullet forceps

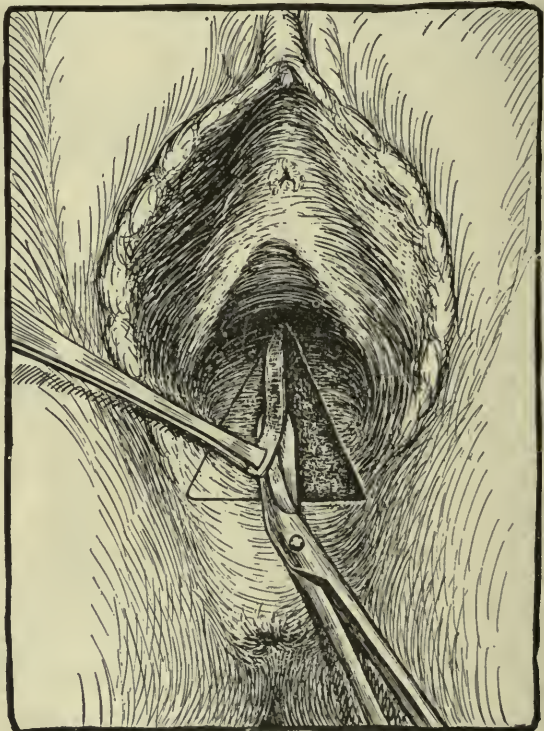


FIG. 18.—DENUDATION BY SUCCESSIVE STRIPS IN PLASTIC OPERATION ON THE PELVIC FLOOR.

underlying tissues. This procedure is much used by many operators in preference to denudation. In certain of the modern operations of plastic surgery for the cure of cystocele and rectocele and of vesico- and rectovaginal fistula it is a necessary technic.

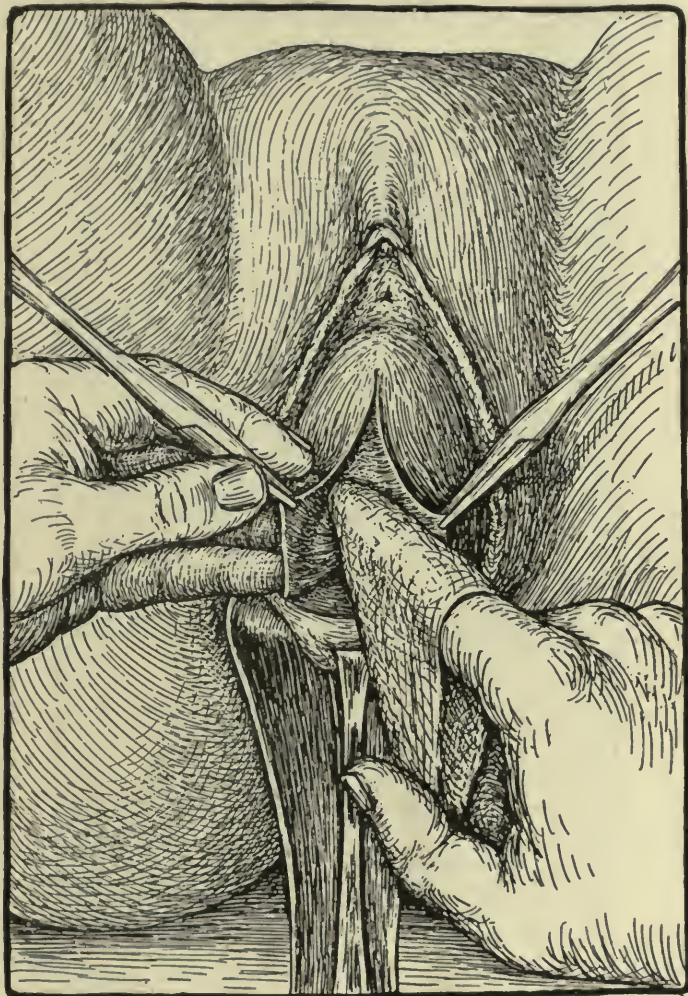


FIG. 19.—INCISION AND METHOD OF SEPARATING THE BLADDER FROM THE ANTERIOR VAGINAL WALL.

Anterior Vaginal Wall.—In separating the anterior wall from its attachment to the bladder, which is the first step in operations for the radical cure of cystocele, a longitudinal incision is made in the middle line of the vagina from just below the external meatus to its junction with the cervix. The incision is to be made deep enough to go through the full thickness of the vaginal wall. The edge of the incision is picked up with mouse-tooth forceps, and the handle of the scalpel used to peel back the vagina from the bladder. As soon as the

line of cleavage is demonstrated it is easy to extend the separation with the handle of the scalpel or with the finger covered with a piece of gauze (Fig. 19). The same procedure is done on the other side until the entire anterior vagina

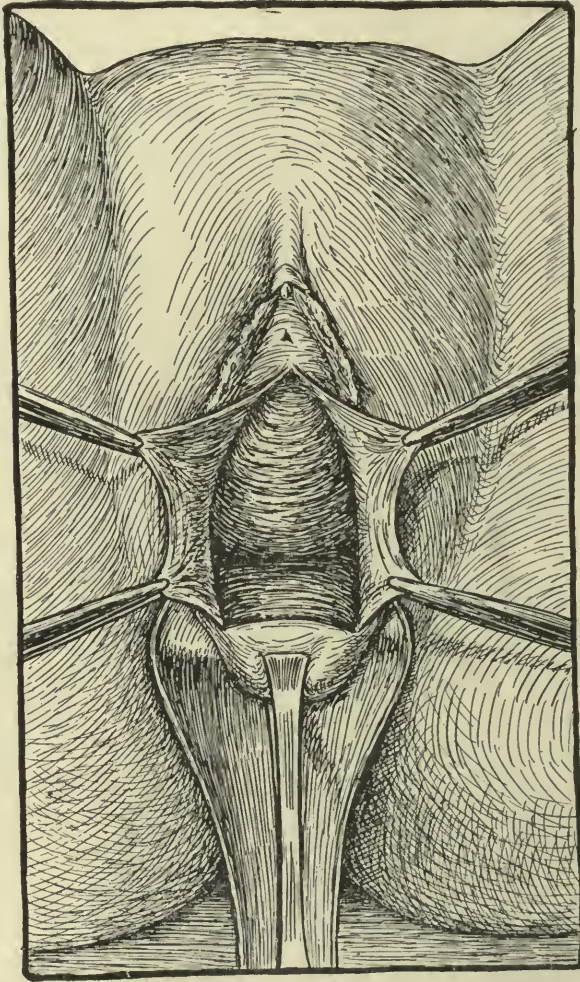


FIG. 20.—ANTERIOR VAGINAL WALL SEPARATED FROM UNDERLYING BLADDER. Note the transverse incision at the cervical end of the longitudinal incision.

is separated from its attachment to the underlying bladder. This longitudinal incision is frequently connected with a transverse incision at its cervical termination, thus making an inverted T, and giving a very wide exposure of the uterus and broad ligaments and a free entrance into the abdominal cavity (Fig. 20).

Anterior Colpotomy.—To enter the abdominal cavity, the bladder is then pushed off the face of the uterus with the index finger, which is covered with gauze, until the peritoneum is reached (Fig. 21A). This is grasped with a

forceps and carefully opened transversely with scissors. The fundus uteri may then be delivered through this incision. See Figure 21B.

Posterior Vaginal Wall.—The posterior vaginal wall may be separated from the rectum in a similar manner. It is wise to insert into the rectum a sponge forceps, holding a gauze sponge well vaselined, to act as a guide. The junction of the vagina to the skin surface of the perineum is incised from side to side

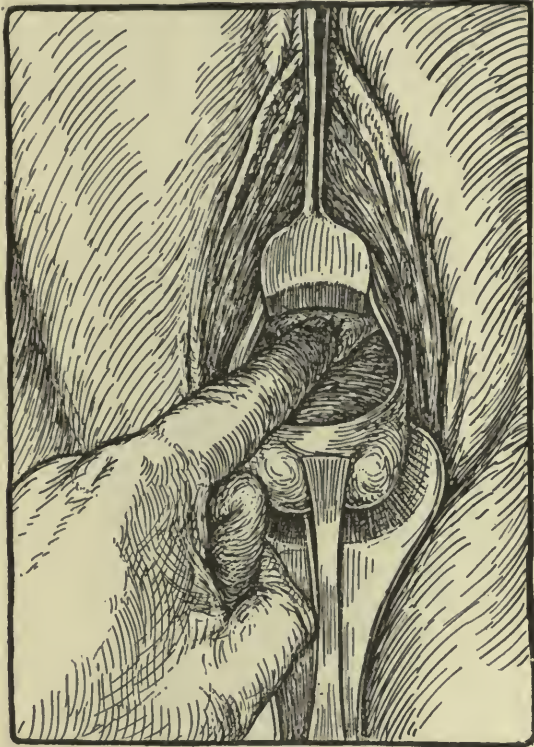


FIG. 21 A.—THE BLADDER PUSHED OFF THE CERVIX AND UTERUS. Index finger resting on the uterovesical plica of the peritoneum.

and a pair of blunt-pointed scissors, curved on the flat and with long blades (Fig. 8), are used to carefully snip the tissues at the junction of the vagina and the perineum (Fig. 22). When the perineal tissues have been separated and the rectal wall is reached, the scissors are kept closed and gently pushed forward until the line of cleavage between the vagina and the rectum is found. The blades of the scissors are then opened widely, thus separating the tissues from each other without danger of perforation. The vaginal wall may be separated from the rectum by this method to whatever extent is required by the operation (Fig. 23).

This method of flap splitting is employed in the operation of rectopexy for the cure of rectocele, the rectum being entirely freed from the vagina up to the culdesac. It is also applicable to the cure of rectovaginal fistulæ.

This method of separating the posterior vaginal wall from the underlying structures is also employed in operations where the edges of the levator ani muscle are to be approximated, and was originated for this purpose by Lawson Tait.

Posterior Colpotomy.—Entrance into the abdominal cavity by this route is easy and is most generally useful for purposes of exploration or drainage of

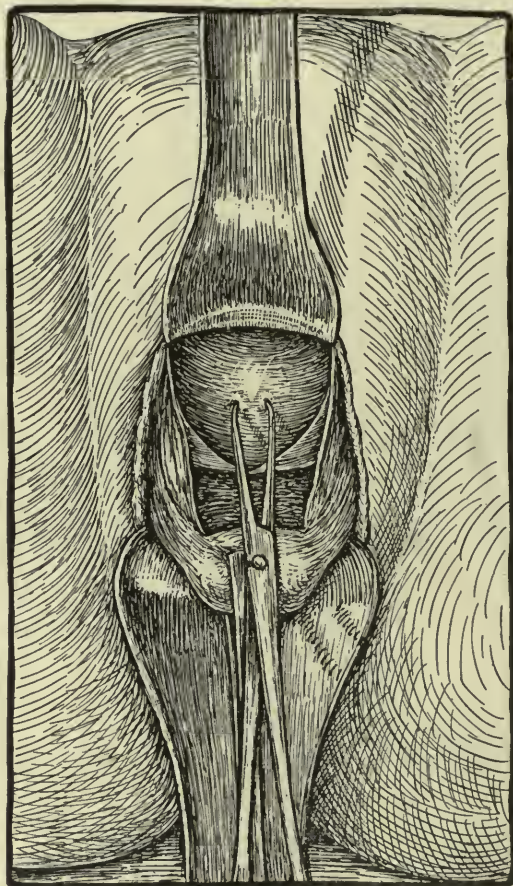


FIG. 21 B.—BRINGING FUNDUS UTERI OUT OF ANTERIOR COLPOTOMY INCISION.

collections of pus. The posterior lip of the cervix, being grasped with a Jacobs' forceps, is drawn strongly upward, so as to expose the posterior fornix. A transverse cut is made through the vaginal wall, about half an inch from the cervical attachment of the vagina. The universal scissors (Fig. 7) are most suitable for this purpose. The peritoneum is then grasped with forceps and cut open with the scissors in the median line. The opening is then further widened by stretching with the fingers or by the use of a branched dilator (Fig. 24).

Pelvic Drainage.—Drainage of collections of pus in the pelvic cavity is

most satisfactorily accomplished by this route and the employment of suitable drainage tubes. A form of drainage tube used by me with much satisfaction is shown in Figure 25.

A piece of drainage tubing of the diameter of the index finger and about 6 in. in length is cut with a large fenestra as illustrated. The tube is then bent at the

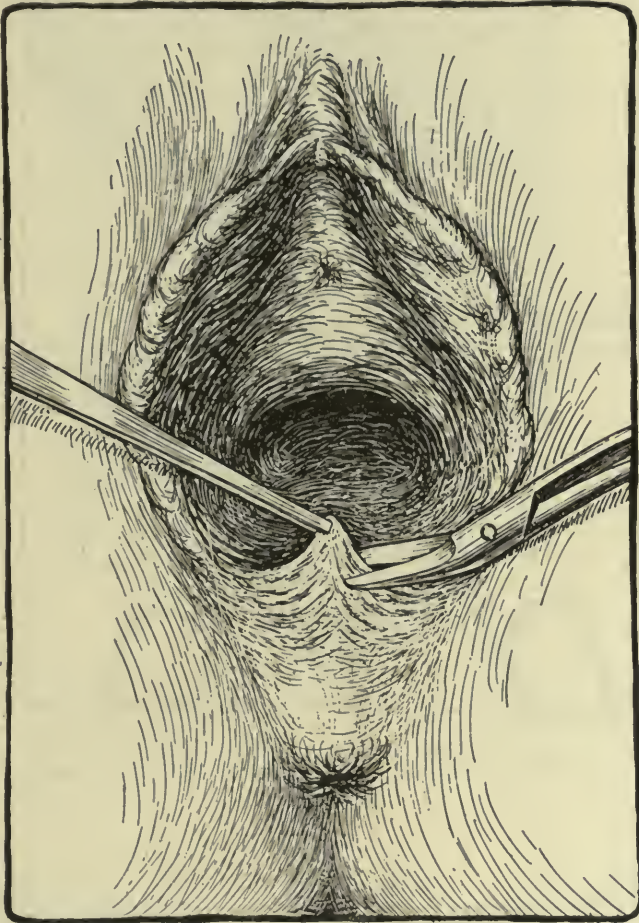


FIG. 22.—BEGINNING THE DENUDATION ON THE POSTERIOR VAGINAL WALL AT THE MUCOCUTANEOUS JUNCTION OF THE VAGINA WITH THE PERINEUM.

center of the opening, and the arms of the tube are sutured together with a single silkworm-gut suture, which is left long, with a cervix needle attached. The doubled tube is inserted into the cavity to be drained through the posterior colpotomy incision, and the silkworm-gut suture is passed through the posterior lip of the cervix and tied. This secures the tube in position as long as desired. The long arm of the tube extends down to the vulva, where it may readily be exposed for the easy insertion of the nozzle of the irrigating apparatus for the purpose of keeping the tubes from being blocked with clots and débris (Fig. 26).

Rubber Tissue Drains.—In operations involving extensive dissection of the bladder from the vagina and the uterus, it is advisable to employ some form of drainage on account of the oozing from the large area of denuded surfaces, otherwise a troublesome hematoma may interfere with a proper union or become infected.

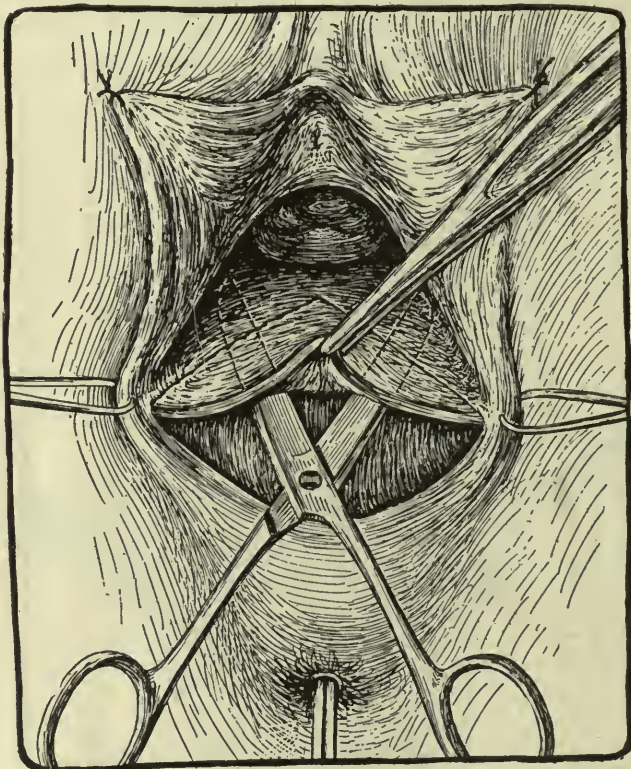


FIG. 23.—METHOD OF SEPARATING THE TISSUES OF THE POSTERIOR VAGINAL WALL AFTER THE LINE OF CLEAVAGE BETWEEN THE VAGINA AND THE RECTUM HAS BEEN FOUND.

An admirable drain for this purpose is a piece of twisted rubber tissue, to the center of which is fastened a strand of silk. The drain is then bent into a V and passed through an opening in the line of suturing, each arm of the drain extending up either side of the uterus on the anterior surface of the broad ligaments. The silk strand is to facilitate the withdrawal of the drain on the fourth or fifth day (Fig. 27).

Gauze.—Whenever gauze is to be used in the vagina or uterus for over 24 hours, for purposes of drainage or for packing for hemorrhage, iodoform gauze is preferable to plain gauze, for it does not become foul so readily and may be left in situ 4 or 5 days. When used through a posterior colpotomy incision, it should be surrounded with rubber tissue at that part which is next to the incision, as this will greatly facilitate its removal and save the patient from severe pain at that time.

At the completion of the operation, a short piece of gauze should be inserted into the lower portion of the vagina, so as to cover the line of suturing on the perineum. This will act as a guide to the nurse as to the position of the external

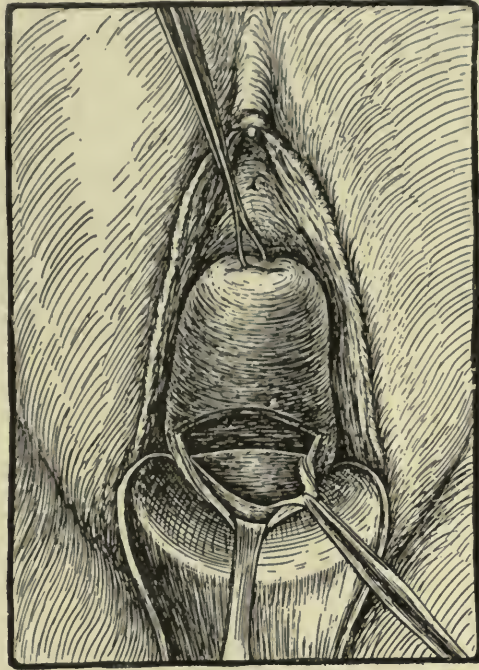


FIG. 24.—POSTERIOR COLPOTOMY.

meatus in catheterization. This gauze should be removed at the end of 24 hours. A sterile gauze dressing is applied and held in place with a T-bandage.

Postoperative Care of Vaginal Operations.—It is not necessary that the patient's limbs be tied together. As a rule, sufficient morphia should be given during the first twenty-four hours to keep the patient free from pain.



FIG. 25.—RUBBER DRAINAGE TUBING WITH LARGE FENESTRA BEFORE BENDING.

CATHETERIZATION.—In plastic operations on the pelvic floor and the bladder, the catheter should be used every 6 or 8 hours for the first 2 days. After that time, the patient should be encouraged to void. If possible, the catheter should not be used at all after cervical operations or curettage.

On account of the great danger of cystitis from postoperative catheterization in cases having had operations involving the wall of the bladder, an exact aseptic

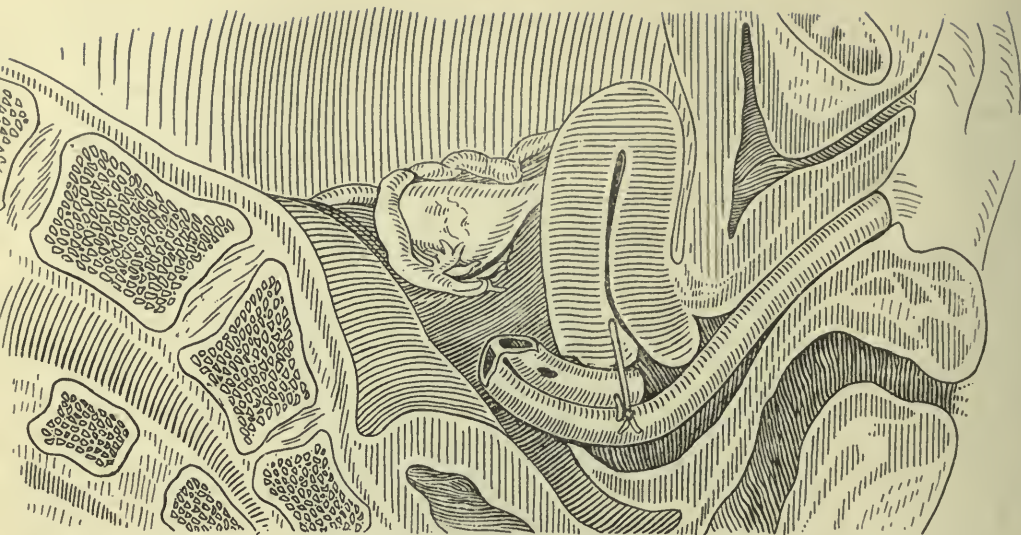


FIG. 26.—AUTHOR'S DRAINAGE TUBE IN SITU. The tubing is doubled at the large fenestra and fastened together with a suture. Note the same suture fastening the tube to the cervix and the long arm of the tube extending to the vulva for convenience in irrigating.



FIG. 27.—RUBBER TISSUE DRAIN TIED WITH A STRAND OF SILK TO WHICH A PIECE OF IODOFORM GAUZE HAS BEEN ATTACHED.

tie technic should be insisted upon. After bathing the external genitals with a bichlorid solution and sterilizing the hands, the nurse should separate the labia with the thumb and index finger of the left hand, thus exposing to view the entrance to the urethra. She should then wash the vagina with a 1:2,000 bichlorid solution, using sterile cotton balls. The sterile catheter is taken by its outer end from the receptacle in which it has been boiled, and, after dipping it into a 20 to 25 per cent. solution of argyrol, it is passed directly into the mouth of the urethra, great care being exercised not to touch any other part of the vulva. If it is necessary to continue catheterization, it is wise to leave a little boric acid solution in the bladder and to give the patient urotropin, gr. vii ss, 3 times a day.

After catheterization or micturition, the external genitals should be thoroughly flushed with a 1:2,000 bichlorid solution, or one of 1:5,000 potassium permanganate.

BOWELS.—The bowels should be moved at the end of 48 hours. If the patient is not nauseated, castor oil is probably the most satisfactory purgative. Calomel, in half grain doses every half hour until 2 to 3 gr. are taken, followed by a saline the next morning, is used by many. A soapsuds enema to which 3 oz. glycerin have been added usually suffices to start the bowels if they do not respond to the above medication. The bowels should be kept open daily with a simple enema or mild laxatives.

DIET.—For the first 2 days after the operation the diet should be liquid, and a regular diet can be gradually instituted as soon as the patient desires it.

DOUCHES.—I do not believe it best to give vaginal douches following plastic operations until after the sixth day, as they tend to hasten the softening and disintegration of the catgut sutures. After the sixth day, a daily vaginal douche of 1:5,000 potassium permanganate solution should be given. A soft rubber catheter or small sized rectal tube should be used as a douche nozzle.

OUT OF BED.—After curettage and operations on the cervix, the patient may be out of bed after the sixth day.

After extensive bladder operations, the patient should stay in bed for 14 days, so as to allow a firm union to take place before the parts are subjected to strain.

In the perineal operations the patient may be out of bed on the twelfth day. The sutures in perineal operations may be removed by the twelfth day.

Special Care after Operations for Repair of Complete Laceration of the Sphincter Ani.—**DIET.**—For 1 week the diet should be restricted to liquids which have little or no residue. Albumen water, thin broths, tea, coffee, junket, soft cooked eggs, fruit juices, etc., may be used.

BOWELS.—The bowels should be kept closed for 4 days. On the morning of the fifth day, an enema of olive oil is slowly injected into the rectum and allowed to remain, with the idea of softening any fecal matter that may have accumulated in the rectum. In the early afternoon, an ounce of castor oil is administered, and when the patient experiences an inclination for an evacua-

tion another oil enema is given high through a rectal tube. An evacuation should be secured in a similar manner every alternate day following, except that compound licorice may be substituted for the castor oil.

ABDOMINAL OPERATIONS

Preparation before Operation.—It is best in all abdominal cases to prepare the vagina and external genitals for operation, as well as the abdomen, as it frequently happens that it is necessary to invade the vagina from above and a sterile field is thus assured.

The vagina and external genitals and the mons veneris are prepared after the manner previously described, and then the abdomen from the nipple line to the middle of the thighs is cleansed with alcohol, followed by ether, and covered with a sterile dressing of gauze.

Two hours before the patient goes to the operating room the dressings are removed and the entire abdominal field is painted with a half strength solution of tincture of iodine (3.5 per cent.) and again covered with sterile dressings.

The other details of the preparation are exactly the same as described for vaginal operations.

In cases where an hysterectomy is to be done, as soon as the patient is anesthetized and before the final preparation of the abdomen is made, the vault of the vagina should be exposed with a speculum and the cavity of the uterus injected with tincture of iodine with an intra-uterine syringe, and the vaginal vault should also be painted with the same solution. This insures a sterile field if either a supravaginal or a panhysterectomy is done.

The patient having been placed on the table in the dorsal recumbent position, a small firm pillow should be placed under the lumbar region. This expedient will prevent or ameliorate the troublesome backache so common after operations.

The dressings having been removed, the abdomen is first painted with a 1:1,000 solution of iodine crystals in benzine. The excess is carefully wiped off and allowed to evaporate. A 3.5 per cent. solution of the iodine is next applied, and the abdomen is covered with sterile towels and the laparotomy sheet.

Operating Table.—The Boldt operating table, or one modeled on the same principle, is the most generally useful for gynecological abdominal operations. The Trendelenburg position, as obtained with this table, is more correct and far more convenient for the operator than that given with tables which pivot at the center.

The Abdominal Incision.—**THE LONGITUDINAL INCISION.**—The longitudinal incision is most generally useful, although the transverse or Pfannenstiel incision is preferable for certain operations. Many operators employ the latter incision as a routine procedure, on account of the very strong abdominal wall



FIG. 28.—AUTHOR'S MODIFICATION OF THE KAMMERER INCISION THROUGH THE ANTERIOR SHEATH OF THE RECTUS MUSCLE NEAR THE CENTER OF THE MUSCLE, ON THE SIDE NEAREST THE OPERATOR.

that is secured by this method. It takes more time to enter the abdomen in this way and it makes a larger wound.

I use a method of longitudinal incision which is as easy and as quick as the

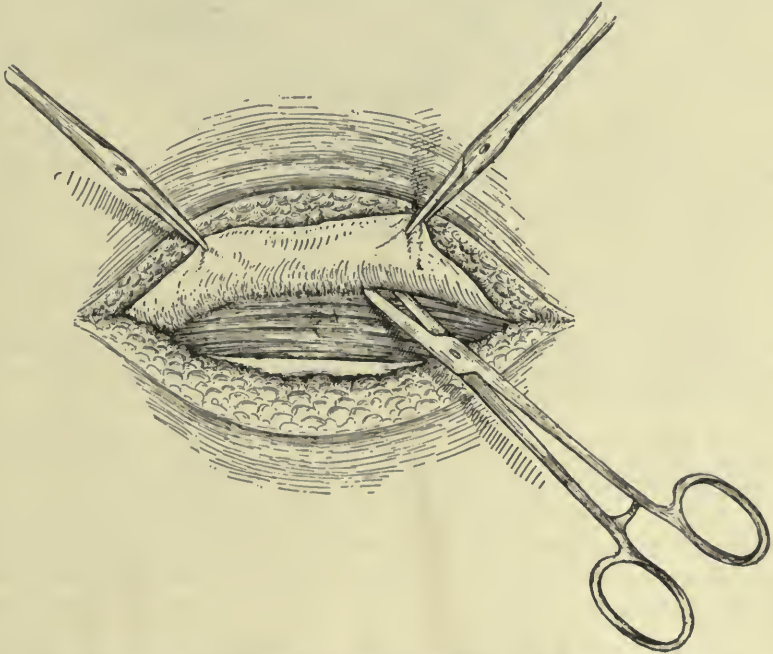


FIG. 29.—FREEING THE MUSCLE FROM THE INNER BORDER OF THE SHEATH.

ordinary way of opening the abdomen between the recti, yet gives a cicatrix which is amply strong and eliminates all danger of a subsequent ventral hernia. Before making the incision through the skin in the median line, 3 or 4 transverse nicks, $\frac{1}{2}$ in. in length, are made along the line of the incision. The in-

cision is carried through the center of these cross marks so that they may be used as landmarks to enable the operator to secure a perfect approximation of the skin edges in the subsequent suturing. The incision commences just above the symphysis and is carried down to the rectus fascia in the median line.

The length of the incision will naturally vary with the needs of each case; 8 to 10 cm. will suffice, unless a growth of some size has to be dealt with.

The fat is dissected back for an inch or more on the side nearest the operator, so

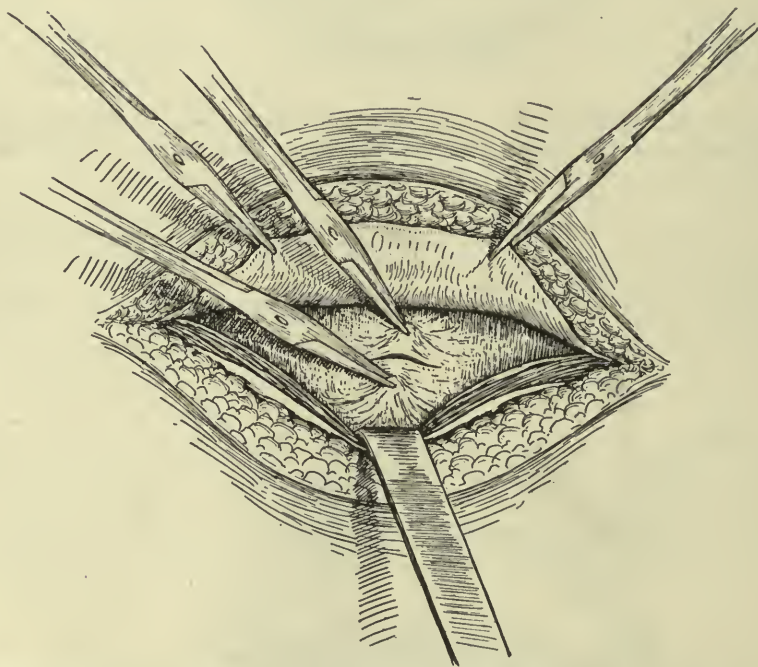


FIG. 30.—RETRACTION OF THE RECTUS MUSCLE FROM THE MEDIAN LINE OUTWARD AND INCISION THROUGH THE POSTERIOR SHEATH OF THE MUSCLE, THE FAT, AND THE PERITONEUM DIRECTLY UNDER THE CENTER OF THE MUSCLE.

as to expose the fascia over the center of the rectus muscle. The fascial sheath is then opened at or near the center of the belly of the muscle (Fig. 28).

The cut edge of the fascia opposite the operator is then grasped with 3 clamps and they are held straight upward by the assistant, while the operator rapidly frees the inner border of the muscle from its sheath by blunt dissection (Fig. 29). The muscle having been still further separated from its posterior sheath, it is retracted from the midline outward with a small ribbon retractor, thus exposing the tissues underneath.

The inferior sheath of the rectus, the subperitoneal fat, and the peritoneum are picked up with forceps and are incised $1\frac{1}{2}$ in. from the median line, or near the center of the muscle. In closing the incision, the structures are replaced and united in their normal relations.

By this method of entering the abdomen, it will be seen that the incision does not go through the thickness of the abdominal wall in the same plane, and

that the whole belly of the rectus muscle is interposed under the incision in the rectus fascia, to act as a barrier to a possible hernia. This is a modification of the well-known incision of Kammerer for appendicitis, in which the rectus muscle is displaced from without inward, it being adapted to the median line and the muscle being displaced in the reverse way (Fig. 30).

TRANSVERSE INCISION.—Pfannenstiel's method of opening the abdomen transversely is particularly useful in cases where it is desired to enter the abdomen for intra-abdominal work and at the same time to shorten the round ligaments in the inguinal canal, or at or near the lateral ring, as only 1 incision is necessary and it gives easy access to the region of operation. It also has the cosmetic advantage of the cicatrix being hidden in the suprapubic crease and by the pubic hair. Hernia is practically impossible with this incision.

A somewhat crescentic incision of the skin and fat is made, the convex border lying just above the symphysis in the suprapubic crease, if present, and the ends extending inside and parallel to the inguinal canal. The fascia of the rectus muscles and the aponeurosis of the external oblique having been exposed, they are incised in the same line as the skin incision and are dissected upward until the rectus muscles are sufficiently exposed to allow of their separation and the longitudinal division of the peritoneum in the middle line. Owing to the incision running across the blood supply in the skin and fat, it is necessary to ligate the vessels as they are encountered during the course of the dissection.

Exposure of the Pelvic Cavity.—The modern laparotomy differs from the operation of earlier years not only in the more perfect attainment of asepsis but in the better exposure of the abdominal contents, so that the operation is done under direct vision rather than by the sense of touch. Consequently, a more accurate diagnosis can be made, adhesions may be separated more safely, blood-vessels may be more securely ligated, and far more extensive operations may be performed and with greater gentleness, owing to the fact that a better and wider exposure of the field of operation can be obtained by the modern technic than was formerly the case.

The Trendelenburg posture and the self-retaining retractor are the principal aids which have rendered the operation easier to the operator and safer for the patient.

The abdomen having been opened by either the longitudinal or the transverse incision, the edges of the wound should be protected with gauze pads or towels clamped to the skin with towel clamps. This technic is especially necessary where an iodine preparation of the skin has been used, as considerable chemical trauma of the intestinal peritoneum may be caused by the iodine, with resulting adhesions.

SELF-RETAINING RETRACTOR.—The self-retaining retractor, illustrated in Figures 31 and 32, was designed by me. It is a modification of the Doyen retractor, which consists of a standard which is placed between the thighs of the patient and close up to the symphysis. A clamp with a thumb screw at the top

of the standard firmly holds the handle of the retractor. The legs of the standard curve outward and forward underneath the thighs of the patient and should rest on the table. The clamp at the top of the standard will then be parallel with the horizon.

The blade of the retractor is placed transversely in the abdominal opening and by its width spreads the incision wide open. One of the most valuable

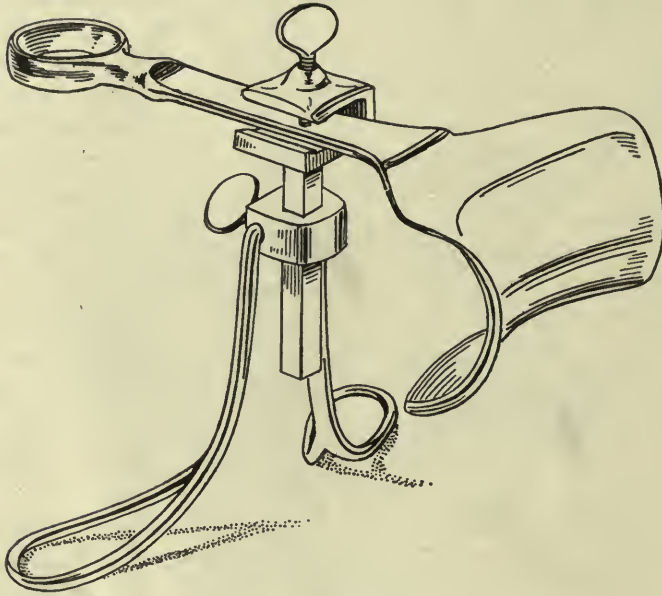


FIG. 31.—WARD'S SELF-RETAINING RETRACTOR.

features of this type of instrument is that it is held absolutely fixed or rigid by the standard and cannot become displaced by the manipulations of the operation. Three blades of different width are used, according to the size of the abdominal opening. It is equally adaptable to the longitudinal or the transverse incision.

The original instrument of Doyen had no means of adjusting the height of the clamp to the size of the patient. I attached the clamp to a square shaft which passes through a square slot in the head of the standard. A thumb-screw, which is easily accessible after the instrument is in place, enables the clamp to be speedily fixed at any desired height. The handle of the retractor blade in the original instrument was very long, and I had this shortened to conform to the requirements of an incision in the lower abdomen. Two prongs near the end of the handle were removed, as they were unnecessary and sometimes interfered with the approximation of the patient's thighs. The corners of the blade were rounded off so as to prevent injury to the walls of the pelvis. For the satisfactory use of this instrument, it is essential that attention be paid to the details of placing the standard in position in the proper manner.

After the final preparation of the abdomen has been made and before the sterile coverings are put in place, the unsterile nurse stands at the foot of the table and grasps each leg of the patient with either hand. She raises and flexes the knees and allows them to fall widely apart. A sterile towel is then laid obliquely across the thigh and lower abdomen of one side, care being taken that it overlaps the vulva. Another towel is placed in the same manner on the opposite side. The towels are then tucked underneath each thigh and, if they have

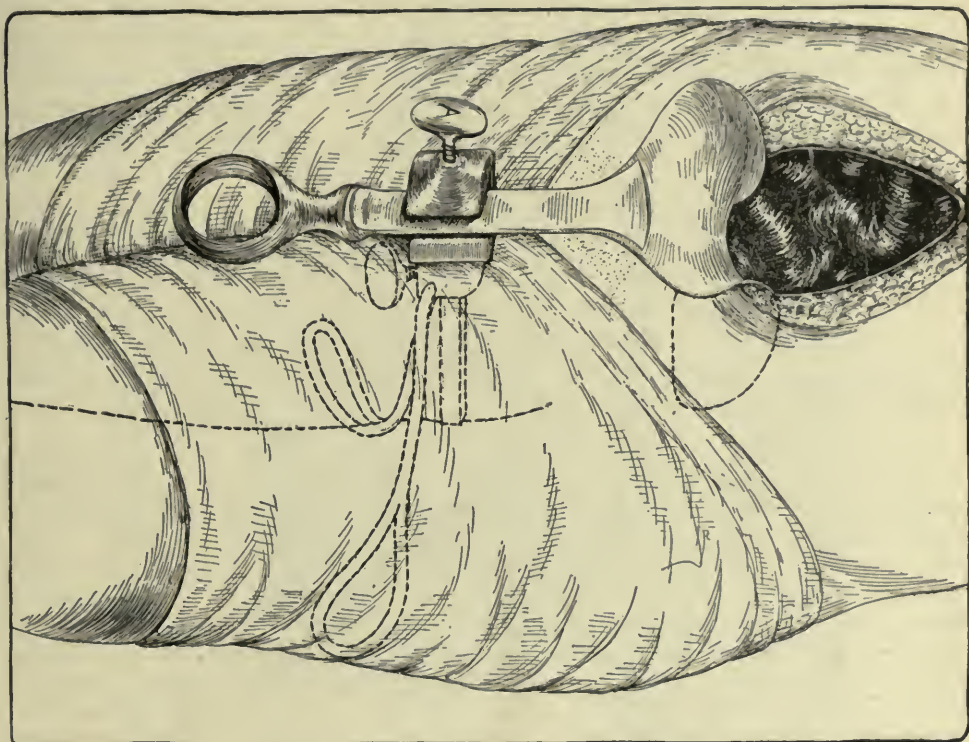


FIG. 32.—WARD'S SELF-RETAINING ABDOMINAL RETRACTOR IN POSITION. The blade lies within the abdomen across the lower end of the wound and the handle is firmly attached to the top of the standard by thumbscrew A. Note that the standard is adjustable in height to the thickness of the patient's thigh.

been properly placed, a double thickness of towel completely covers the vulva and symphysis.

The standard is then placed between the thighs and close up to the symphysis, care being taken to see that its legs curve forward toward the patient's feet and that the clamp is square with the patient and parallel to the horizon. Its height is then regulated so that the slot of the clamp will rest on a level with the surface of the symphysis while under traction, and it is securely fastened with the thumbscrew. The knees of the patient are then tied together with a bandage and the sterile coverings are put in place.

After the abdomen is opened, the retractor blade is inserted so as to include

the entire thickness of the abdominal wall. It is then rotated until transverse to the patient and the handle is inserted into the slot of the clamp and secured with the thumbscrew. Its use procures a wide and rigid retraction of the walls of the incision and it avoids the oft-repeated trauma of manually held retractors, besides freeing the hands of the assistants for other work. It also protects the anterior half of the incision from exposure to infection.

Of the many other forms of self-retaining retractors in use, the Mayo-Balfour is probably one of the best.

TECHNIC.—After the retractor blade is in place, the patient should be placed in a marked Trendelenburg posture, to allow the intestines to gravitate to the upper abdomen and away from the incision. They may be gently assisted with a sponge-holder containing a large gauze pad moistened in hot saline solution.

Gentleness of manipulation and the avoidance of all unnecessary handling of the intestines will do more toward insuring a smooth and uneventful convalescence than anything else except asepsis. The investigations and teachings of Crile show the importance of the avoidance of all unnecessary trauma.

When the intestines are all out of the pelvis and in the abdomen above the abdominal opening, they should be held in this position by gauze carefully packed under the abdominal wall.

Instead of employing the usual numerous laparotomy pads of gauze with tapes or iron rings attached to prevent their loss, I believe that the gauze roll is more convenient for this purpose and much safer, as it does away with the necessity of counting. The numerous suits for malpractice prove that the danger of a miscount still exists, in spite of the elaborate and complicated systems devised for the prevention of such errors. The roll should be made of gauze folded in 6 thicknesses. It should be 6 in. wide and 3 yd. long. This gauze is wrung out in hot saline solution and unrolled by the assistant, while the operator gently packs as much as is necessary under the edge of the incision in such a way as to make a dam to prevent the descent of the intestines. The assistant then clamps the remainder of the roll with an artery forceps to the abdominal covering (Fig. 33).

The intestines having been walled off, the table may be lowered to a moderate incline and the operation proceeded with.

A careful inspection of the pelvic contents should first be made and the course of the operation decided upon to meet the conditions found.

Adhesions should be dealt with as far as possible by careful cutting with blunt-pointed scissors under direct vision. The model shown in Figure 7 is very useful for this sort of pelvic work. Separation of adhesions by tearing apart with the fingers is to be avoided, if possible.

In operations where new surfaces have been left, following denudation of the peritoneum or the separation of adhesions, an effort should be made to cover over all such surfaces, as far as possible, with peritoneum. When extensive denudation has occurred in the pelvic cavity, it is sometimes possible to

utilize the sigmoid to cover the pelvic inlet by attaching it with a few sutures to the posterior surface of the uterus and broad ligaments, so that the intestines cannot enter the true pelvis and become adherent there. Raw stumps, especially omental stumps, may be rolled on themselves and secured with a suture, so that they cannot become adherent to adjacent organs.

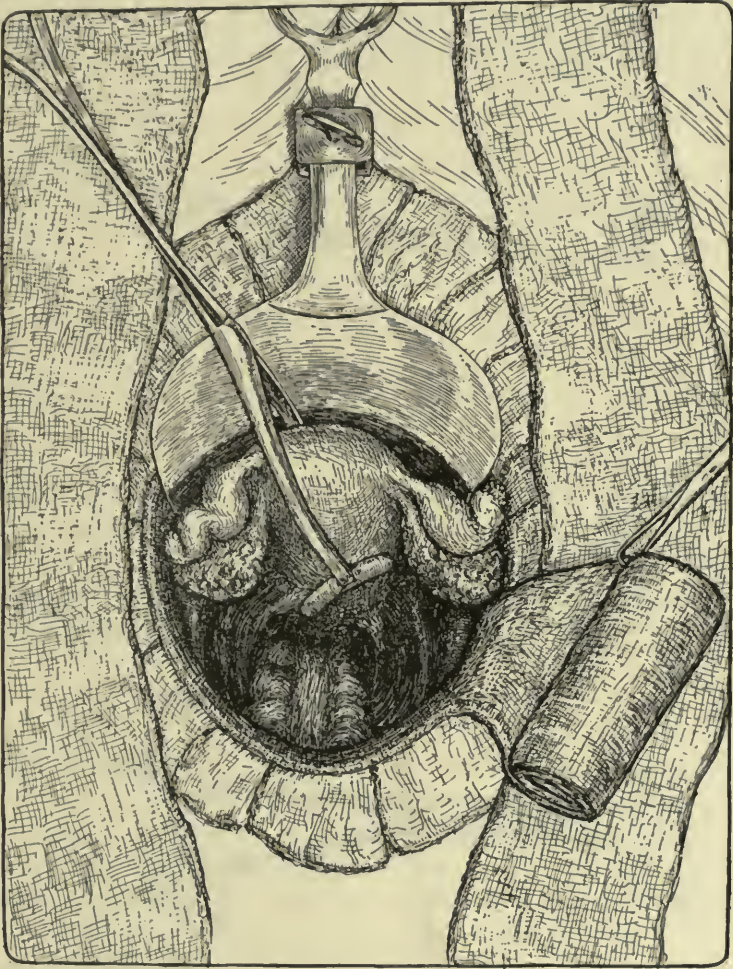


FIG. 33.—ROLL OF GAUZE INSTEAD OF LAPAROTOMY PADS OR SPONGES TO KEEP BACK THE INTESTINES.

Should pus be spilled in the pelvic cavity during the course of the removal of a tubal abscess or growth, it should be carefully wiped out with gauze sponges until dry. All flushings with solutions of sterile water should be avoided. With the wide exposure obtained by the retractor, the careful protection of the wound edges with gauze, the walling off of the intestines with the gauze roll, and the avoidance of flushing, the danger of the dissemination of infection is reduced to the minimum.

To lift the uterus out of the pelvis some form of uterine clamp that does not mutilate its surface should be used to grasp the fundus, if it is to be retained. Volsella forceps cause unnecessary bleeding and injury, which may result in adhesions. The instrument shown in Figure 33 is a very satisfactory one for this purpose.

Light rubber-tipped clamps should be used for grasping such delicate structures as the tubes, the ovaries, and the intestines (Fig. 34), and curved clamps are of assistance in work on the broad ligaments (Fig. 35).

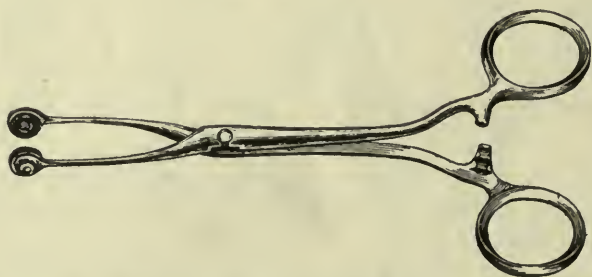


FIG. 34.—BARRETT'S RUBBER-TIPPED FORCEPS FOR GRASPING AND HOLDING DELICATE STRUCTURES IN ABDOMINAL WORK.

If drainage is deemed necessary, the vaginal route is to be preferred. A pair of sharp-pointed curved seissors is passed through the culdesac and forward into the vagina. The blades are then widely separated.

An iodoform gauze drain about the size of the index finger and about 12 to 18 in. long is surrounded at its lower end for about 6 in. with rubber tissue.

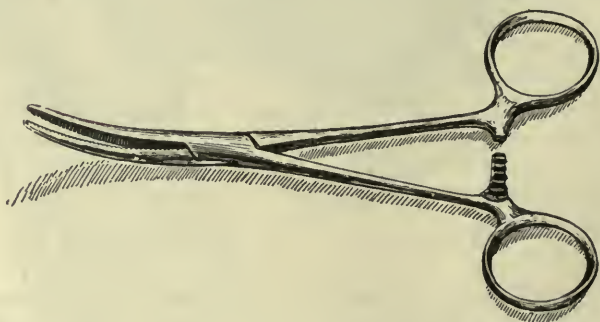


FIG. 35.—OCHSNER-MAYO'S CURVED CLAMP FOR USE ON THE BROAD LIGAMENTS.

This is fastened to the gauze carrier illustrated in Figure 36 and the end of the carrier is passed into the vagina and out of the vulva, where it is seized from below and the gauze drawn to the vaginal outlet. This instrument greatly facilitates the maneuver and avoids the danger of contamination which is possible when a forceps is passed from the vagina into the abdomen to grasp the gauze and draw it down.

Unless the patient's condition prohibits it, at the completion of any operation on the pelvic organs advantage should be taken of the opportunity presented to make an exploration of the condition of the appendix. If it is diseased, it should, of course, be removed.

I believe, as do many operators, that it is best to remove it as a routine procedure, whether diseased or not. The presence of adhesive bands in the neighborhood of the ileocecal junction, which produce "Lane's kink," should be carefully sought for and, if present, should be released. Likewise, a "Jackson's membrane," covering the caput coli, is to be looked for.

The degree of ptosis of the stomach and large intestine and the kidneys should be noted, and finally the hand should be passed to the region of the gall-bladder and its condition studied.



FIG. 36.—AMANN'S GAUZE CARRIER.

Closure of the Abdomen.—The intestines having been returned to their normal relations and the omentum drawn down into its natural position, the peritoneum is picked up by clamps and sutured with a continuous doubled suture of No. 1 plain catgut. The ends of the suture are knotted together, and the needle is passed through the inner surfaces of the incision. It is not necessary to tie this doubled suture at this point, as the needle is passed between the 2 strands and drawn tight. This saves the time of tying. The suture is continued down on the inner surface of the peritoneum as in a right-angled Cushing suture, so that the cut edges of the peritoneum are turned upward into the wound, as shown in Figure 37. This leaves a perfectly smooth peritoneal surface in the abdomen, and is an important factor in preventing formation of adhesions. When the end of the incision is reached, the needle is cut off and one end of the suture is passed through the last bite, and both ends are drawn tight and tied together, as shown in Figure 38.

The rectus muscle is next replaced and fastened to its sheath with 3 or 4 interrupted catgut sutures placed along its inner border (Fig. 39).

Two or 3 silkworm-gut stay sutures are then placed, the needle is passed through the skin and fat and is then reversed and passed through the fascia, reversed again and brought out on the opposite side through the fat and

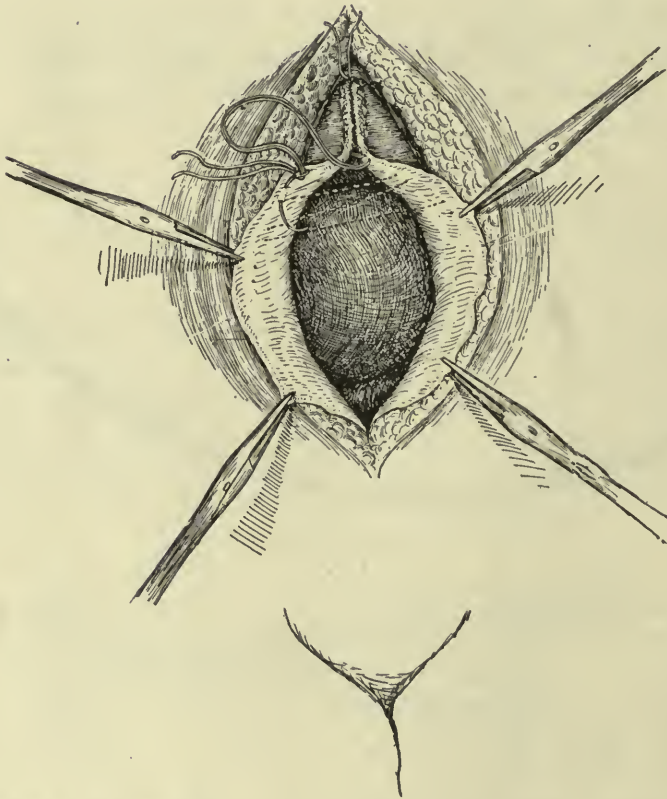


FIG. 37.—CLOSURE OF THE PERITONEUM BY A CONTINUOUS RIGHT-ANGLED CUSHING SUTURE PLACED ON THE INNER SURFACE. Note that the cut edges are thus turned upward into the wound.

skin. This makes a figure-of-eight stay suture, which supports the fascia (Fig. 40).

The rectus fascia is then sutured with a continuous doubled No. 1 chromic catgut suture. It is fastened in the same way as the peritoneal suture and is then interlocked until the center of the incision is reached, when it is tied in the same manner. It is then started again at this point and continued as before to the end of the wound. This tying in the center of the fascia makes a com-

plete failure of union less likely to occur if the suture should break during vomiting.

The skin is closed by an interlocking catgut or silk suture or by a subcuticular stitch if desired. A roll of gauze is laid along the line of the incision and the stay sutures are tied over it. This prevents cutting of the skin and insures the dressing being kept in place over the incision. A roll of gauze is placed on either side of the center roll, to make equable pressure, the gauze dressings are applied, and the abdomen is strapped with adhesive plaster.

After-care.—As soon as the patient is returned to her bed, a so-called “shock enema” should be given, consisting of ammonium carbonate, gr. xx; whiskey, oz. i; and saline, oz. vi. This is allowed to run into the rectum slowly. A hypodermic of eserine salicylate, gr. 1/40, is administered at the same time. In my experience, this has seemed beneficial in preventing atony of the intestines and the resulting tympany.

Nothing but small quantities of hot water is given by mouth until the stomach is settled.

When the patient begins to complain of severe pain after coming fully out of the anesthetic, a hypodermic of morphia, gr. 1/4, is given. This may be repeated in sufficient quantity and frequency to carry the patient through the first 24 hours without acute suffering. If there is much distention and she is suffering greatly with gas pains, the rectal tube is inserted high up and left in situ, and after 36 hours, if necessary, the following enema may be injected high up the bowel:

Saturated solution of magnesium sulphate.....	oz. ii
Glycerin	oz. ii
Turpentine	oz. ss
Soapsuds to make one quart.	

This has been very successful, in my experience, in relieving tympany and gas pains. If this does not succeed, the following are very efficient—molasses and milk, of each 1 pint at a temperature of 95° F. or pulv. alum ʒss, aquæ 1 pint.

If the patient is not uncomfortable, the bowels are left alone until the afternoon of the third day, when calomel, gr. iii, in divided doses of 1/2 gr. every half hour is given, followed by a saline cathartic the next morning. The bladder is catheterized every 8 hours for the first day, and after that the patient is encouraged to void.

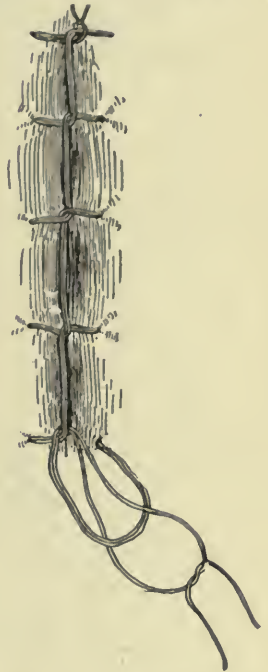


FIG. 38.—FASTENING THE PERITONEAL SUTURE.

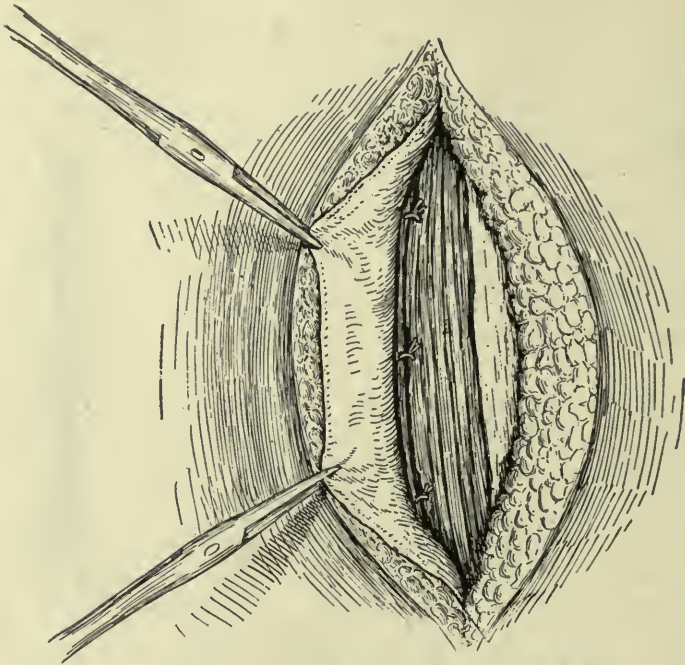


FIG. 39.—INTERRUPTED SUTURES IN THE REPLACED RECTUS MUSCLE.

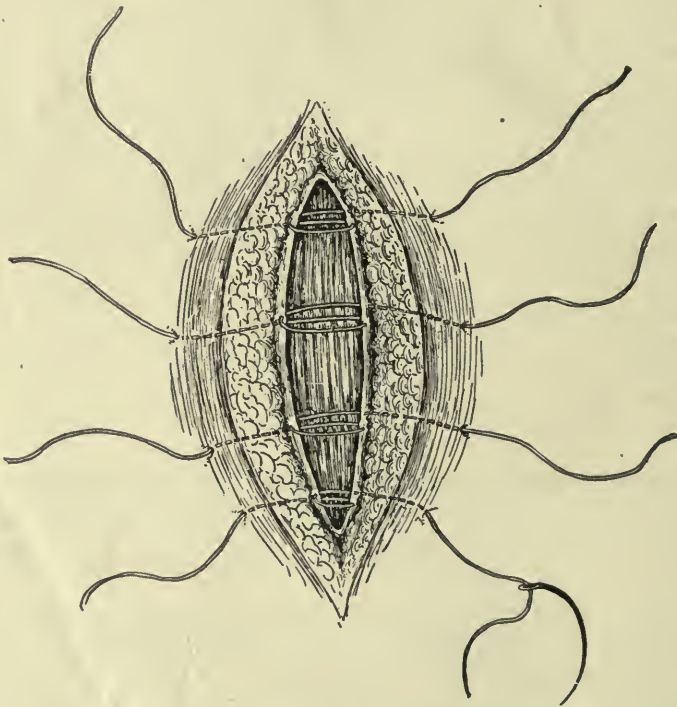


FIG. 40.—FIGURE-OF-EIGHT SILKWORM-GUT STAY SUTURES THROUGH THE FASCIA AND SKIN.

The abdominal incision is dressed on the sixth or seventh day, and the silkworm-gut stay sutures may be removed on the tenth day.

After a normal convalescence, the patient may be allowed to sit up out of bed on the tenth day, and may begin to walk on the fourteenth day.

The treatment of the various postoperative complications that may arise will be discussed in Chapter II, Volume II.

OPERATIONS UPON THE PELVIC FLOOR, VAGINA AND CERVIX,
INCLUDING FISTULÆ AND CONGENITAL
MALFORMATIONS

CHAPTER X

OPERATIONS UPON THE PELVIC FLOOR, VAGINA AND CERVIX, INCLUDING FISTULÆ AND CONGENITAL MALFORMATIONS

WM. E. STUDDIFORD

INJURIES TO THE PELVIC FLOOR AND VAGINA

ANATOMICAL CONSIDERATIONS

The levator ani muscle, together with the strong fascia covering its internal and external surfaces, is conceded to be the essential part of the pelvic diaphragm, but there is no uniformity of opinion as to the relative value of the two elements, the mechanism of their action in giving support and how they are affected by injury. Unfortunately many of the works on anatomy are misleading in their descriptions of the pelvic diaphragm, as the parts are difficult of dissection, many of the structures poorly developed and their relations easily disturbed. The levator ani is a paired muscle which has its origin from the tendinous arch which extends from the lower margin of the pubes to the spine of the ischium, from the inner surface of the superior ramus of the pubes and from the pubes parallel to the symphysis. The fibers coming from the pubes form a distinct muscular band, the pubococcygeus muscle, and are the most important part of the levator. The fibers from the tendinous arch, the ileococcygeal muscle, are slender fasciculi separated by small interspaces. The majority of the fibers from the tendinous arch are inserted into the lateral margins of the coccyx, some are joined with the muscles from the opposite side and others are inserted into the anococcygeal ligament. The fibers of the pubococcygeus arising from the pubes pass directly backward, some of the fibers uniting with the fibers of the external sphincter. Others pass directly to the anococcygeal ligament, while still others join with the fibers from the opposite side posterior to the rectum, some of the fibers mingling with the longitudinal fibers of the rectum. The muscle is in close relation with the side walls of the lower end of the vagina, its fibers mingling with the longitudinal fibers of the vaginal wall. The relation of the muscle to the external sphincter is of the utmost importance and is so intimate that separation by dissection is impossible. Functionally the two muscles must be considered together as forming a strong muscular band extending from the pubis to the coccyx, controlling and embracing the lower end of the rectum and attached to the side walls of

the vagina. It is usual to describe the levator ani as a sling or horseshoe-shaped muscle. It would give a more correct idea of the structure were it described as V-shaped, the angle of the V being much wider posteriorly where the muscles are attached to the ischial spines and narrowing as the anterior fibers (pubococcygeus) attached to the pubic bone are approached. The sides of the V have a slight convexity toward the median line, the apex of the V being the

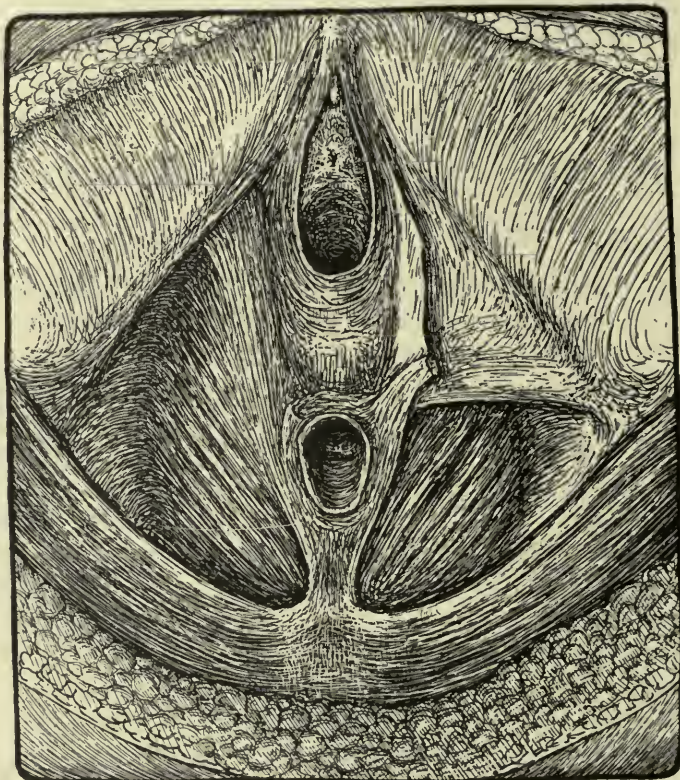


FIG. 1.—PELVIC DIAPHRAGM. Urogenital trigone together with part of external sphincter has been cut away on right side, and its margin shown to the left of the median line. Pubococcygeus on right side exposed. Involuntary muscular fibers shown in space below vagina and between the two halves of the pubococcygeus anterior to the sphincter. Urogenital trigone on left intact. Note the relation of the gluteal muscles posteriorly.

attachment to the coccyx. The open part of the V between the anterior portion of the pubococcygeus muscles is protected by the urogenital trigone made up of two strong layers of fascia, inclosing between them the deep transversus perinei muscles together with some involuntary muscle fibers. The urogenital trigone is attached to the inner margins of the inferior rami of the pubes anterior to the tuberosities of the ischii, its sharp posterior border marking the anterior boundary of the ischiorectal fossæ. It is perforated by the vagina and urethra and fuses with the fascia covering these organs. The posterior surface of the trigone is in relation with the fascia covering both surfaces of the levator ani and gives support to the fibers of the pubococcygeus. The deep transversus

perinei, rising from the inner surface of the tuberosity of the ischium between the layers of fascia and forming part of the posterior half of the urogenital trigone, is attached along with the anterior fibers of the external sphincter to the so-called central tendon of the perineum. It is this part of the perineum that I believe has been improperly described.

In an article of mine in 1909, the importance of the *involuntary muscle fibers* contained in the pelvic floor was emphasized. The study of these fibers was based not only on gross dissection but on frozen sections and microscopic examination of the tissues from the cadaver and microscopic examination of tissue removed from the living subjects during operative procedure. These observations have been confirmed by study of dissections since that time. These investigations showed that the tissue lying between the halves of the levator ani and at the points of attachment of the anterior end of the external sphincter and to the deep transversus perinei muscles in the perineal body was made up largely of involuntary muscle fibers. These fibers running in both a transverse and longitudinal direction are in close relation to all the muscles. So far as I have been able to determine, no fibers from the two halves of the levator ani muscle pass between the vagina and rectum. These involuntary muscle fibers we consider important in the mechanism of the pelvic floor. Their contraction tending to draw the two halves of the levator ani and the deep transversus perinei muscles toward the median line, thus placing these muscles in the most advantageous position for action and by drawing the anterior end of the sphincter forward aid the supporting power of the levator. These fibers undoubtedly increase in size and strength during the pregnancy and account for the increased projection and thickening of the pelvic floor at that time. They also permit the dilatation of the pelvic floor at the time of labor and undergo involuntary changes after labor.

The force of the contractions of the levator ani are directed by the course of its fibers. In the upright position the fibers of the pubococcygeus run almost horizontal from the pubes to a line drawn between the tuberosities of the ischii which marks the posterior border of the urogenital trigone to the posterior surface of which the fascia covering the muscle is attached. Posterior to this line the fibers intermingling with the fibers of the external sphincter pass upward and backward to the coccyx. So that when contraction of the muscles takes place the involuntary fibers approximate the two halves of the muscles toward the median line, the urogenital trigone is pulled upward and forward, closing the vaginal slit. The exaggerated action of these involuntary fibers can be seen in cases of vaginismus. The lower end of the rectum is also drawn upward and forward, and the portion of the muscles posterior to the ischial tuberosities is supported by the upward and forward pressure of the obturator and gluteal muscles on the tissues filling the ischiorectal fossæ. Bearing in mind this relation of the structures of the pelvic diaphragm which is so essential to its proper action, it will be readily seen that the way in which such action could be most easily disturbed would be by injury to the tissues marking the junc-

tion of the involuntary muscle fibers, the urogenital trigone and the fascia covering the pubococcygeus. It is at this point that lacerations of the pelvic floor usually occur, and the effect of such injuries is measured by the extent

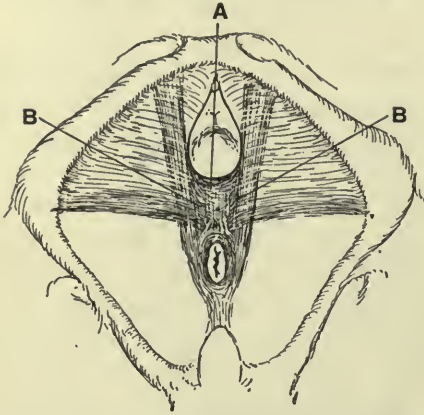


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF RELATIONS OF LEVATOR ANI, EXTERNAL SPHINCTER, AND UROGENITAL TRIGONE. A, involuntary muscle fibers. B, B, junction of involuntary muscle fibers, pubococcygeus and urogenital trigone.

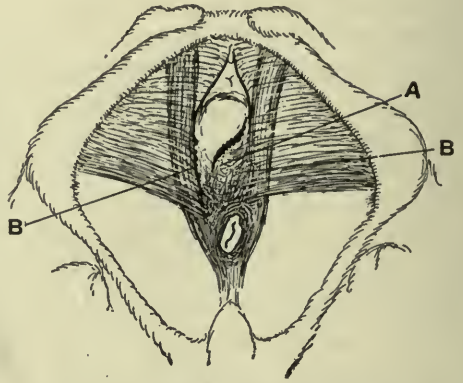


FIG. 3.—LACERATION THROUGH RIGHT VAGINAL SULCUS. B on right side: relation of pubococcygeus, involuntary muscle fibers, and trigone has been destroyed. B on left side: intact, sphincter drawn to uninjured side.

to which the relations of the various structures to each other are disturbed. Figures 2, 3, 4, 5 give a diagrammatic representation of the effect of such injuries. A laceration in the median line through A that does not extend

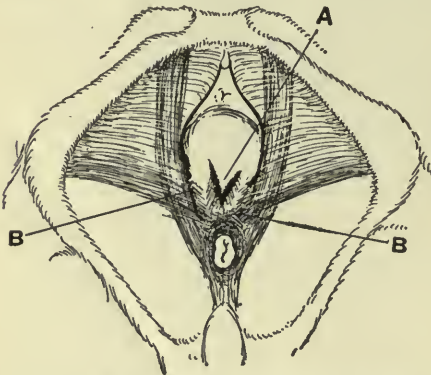


FIG. 4.—RELATION OF PUBOCOCYGEUS, INVOLUNTARY FIBER AND UROGENITAL TRIGONE INJURED ON BOTH SIDES (B, B). Two halves of pubococcygeus sag outward, urogenital trigone retracts. External sphincter drops backward and toward the least injured side. A, vaginal tab of uninjured mucous membrane.

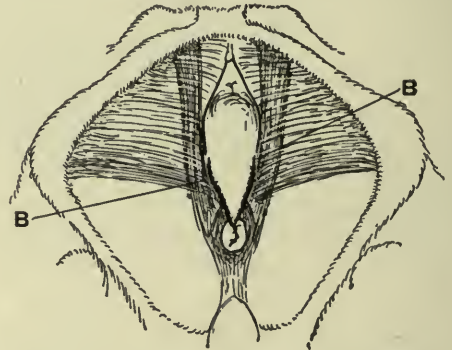


FIG. 5. — LACERATION THROUGH SPHINCTER PUBOCOCYGEUS ON BOTH SIDES. Shows slight sagging. Involuntary fibers divided and urogenital trigone drops downward and shows slight retraction.

below the upper margin of the external sphincter involves some of the involuntary muscle fibers and causes little disturbance of function and is easily repaired at the time of injury. Injury at point B (Fig. 3) on one side allows

the pubococcygeus on that side to sag away from the median line by the detachment of the involuntary muscle fibers. If the tear extends through the skin, as it usually does, the relations of the pubococcygeus on that side to the external sphincter are disturbed and the sphincter is drawn toward the uninjured side. The deep transversus perinei and the urogenital trigone on the injured side retract, pulling the pubococcygeus fibers outward, such retraction increasing in force if the fascia of the levator ani and the trigone are separated from each other. If the tissues at point B (Fig. 4) on both sides are injured, the resulting disturbance of function of the pelvic diaphragm is more marked, the involuntary fibers are torn from the 2 halves of the pubococcygeus and the muscles sag away from the median line. The retraction of the trigone occurs on both sides and the external sphincter drops downward and backward and is usually drawn toward the half of the pubococcygeus from which there is the least separation of the involuntary fibers. The posterior vaginal wall drops downward and backward posterior to a line drawn between the ischial tuberosities.

When these injuries occur during labor they allow the 2 halves of the pubococcygeus to separate as the birth of the presenting part takes place. I have never been able to demonstrate in either recent or old lacerations of the pelvic floor, the rupture of the fibers of the pubococcygeus that is so graphically pictured in many textbooks, and do not believe that it takes place except in badly executed forceps operations. I have seen cases in which the fibers of the pubococcygeus were torn close to their attachment to the symphysis during the withdrawal of the forceps blades. In 2 cases where brutal attempts at delivery by forceps had been made the fibers of the pubococcygeus were torn above the sphincter so that the ischiorectal fossa was opened. I believe that this opening into the fossa will occur whenever the fibers of the pubococcygeus near the perineum are actually ruptured.

The effect of such injuries increases in direct proportion to the length of time during which they are allowed to remain unrepaired and the amount of intra-abdominal pressure to which they are subjected. The muscles atrophy from impairment of function. The fascia becomes stretched and the unsupported action of the sphincter allows the posterior vaginal wall and the rectal wall beneath it to prolapse. The gluteal muscles give some support for a time, by pushing upward on the tissues of the ischiorectal fossæ, but sooner or later the fascia of the levator bounding the inner walls of the fossæ gives way under the strain and the upper angles of the fossæ become flattened and the support of the gluteal muscles is lessened or withdrawn. Where the tear extends through the external sphincter and its function is eliminated (Fig. 5) the sagging of the pubococcygeus is less in evidence because these muscles are relieved of the strain necessary for the maintenance of the action of the sphincter. The relaxation of the pelvic floor occurring in nulliparæ, or after labor in which there has been no visible tear of the vaginal wall, is in my opinion due to stretching or rupture of some of the involuntary fibers. In nulliparæ this

may result from poor development of these fibers, as it often occurs where the genital organs are also poorly developed, or it may be caused by overstrain from excessive muscular action causing badly directed intra-abdominal pressure.

In planning methods for repair of lacerations of the pelvic floor the anatomical relations must be considered and if the injury is not of too long standing and is not associated with marked prolapse of the vaginal wall or muscular atrophy, efforts should be made to restore as far as possible the normal relation of the structures involved. Where the injury is of long standing and its results are severe, the restoration to normal is impossible and the operative procedure should be directed toward giving supporting power to the pelvic diaphragm by readjusting the injured structures in the way best adapted to the individual case. Many methods have been devised for repair of the pelvic floor, but a close analysis of them shows that they are all modifications or combinations of the original procedures devised by Emmet and Tait. The one having for its object the restoration of the fascia and the other the bringing together of the deep muscular structures.

IMMEDIATE REPAIR OF LACERATION OF THE PELVIC FLOOR

Laceration of the pelvic floor should be repaired at the time of its occurrence unless the condition of the patient is a contra-indication, or the tissues are so bruised and edematous that the relation of the parts cannot be accurately determined or are unsuitable for suture. Postponement of the repair can be made for 48 to 72 hours and then carried out if the condition of the patient warrants the administration of an anesthetic and the edema of the tissues has lessened or disappeared. Attempts to repair an extensive laceration should not be made at any time without the aid of competent assistants and a good light. Otherwise the approximation of the tissues is often badly or incompletely done and is apt to result in failure or to invite infection by leaving pockets, in which the lochial discharge is retained. In making an immediate repair the outline of the laceration should be studied. This is best done by grasping with tenaculum forceps the tissues beneath the hymen at the point marking the edge of the laceration on either side; this exposes the laceration into the vaginal sulci. The lower end of the tab of the posterior vaginal wall between the sulci is then grasped with forceps and lifted upward; this outlines the tear in the vaginal mucous membrane and the inner angle of the tear on either side should be brought together by a chronic gut suture, which is not cut but is held by an assistant. The deeper tissues should now be brought together by a buried suture of plain catgut threaded at both ends to full-curved round-pointed needles. This suture is passed through the tissue at the base of the vaginal tab, then deeply through the tissues at the inner side of the right sulcus emerging at the angle (Fig. 10). It is then passed deeply through the exposed pubococcygeus on that side and beneath the posterior surface of the detached urogenital triangle, emerging at the right edge of the tear. The other end of the suture is

introduced on the left side in the same manner. If the external sphincter is drawn toward the least injured half of the levator the suture should be so introduced as to include the anterior end of that muscle on that side. When this suture is tightened, the two halves of the levator ani are approximated in the median line, the torn ends of the trigone and deep transversus perinei are approximated and the end of the external sphincter brought in relation to the other muscles. One or two sutures placed in this way are usually sufficient to bring together the deeper tissues. The edges of the tears in the vaginal mucous membrane are brought together by continuous suture. The skin wound is approximated by interrupted silkworm-gut sutures that pass through the skin and muscular structures, thus supporting the buried sutures that are in place. The upper suture like the crown suture in Emmet's operation should include the tissues beneath the lower end of the vaginal tab. Where the laceration extends through the external sphincter into the rectum the tear in the rectal wall should first be closed by interrupted catgut suture of fine chromic gut, care being taken that the rectal mucous membrane is not included in the sutures. The ends of the external sphincter are now caught and pulled upward, a suture is introduced at right angles to the direction of the fibers of the severed ends (as is done in suturing tendons), tied and one end of the suture cut. The long end of the sutures are tied together, thus approximating the ends of the sphincter. One or two such sutures are usually sufficient. With the ends of the sphincter united, the edges of the laceration are exposed as in the incomplete tear just described. The buried sutures are placed in the same manner, exercising special care that the first suture grasps the fascia behind the edges of the torn sphincter and includes some of the fibers of the muscle itself. When the silkworm-gut sutures are introduced through the skin, the one nearest the anus should go deeply into the tissues at the side of the external sphincter and should include the muscles. The silkworm-gut sutures should be tied just tightly enough to approximate the tear. If tied too tightly cutting of the tissue will surely follow.

SECONDARY REPAIR OF LACERATIONS OF THE PELVIC FLOOR

Choice of operation will depend on the age of the patient, the length of time the injury has existed, the condition of the structures of the pelvic floor and the amount of prolapse of the uterus and vaginal walls that are associated with the injury. In women of child-bearing age in whom the injury is comparatively recent and the muscles have not had time to atrophy or the fascia to stretch, the injured structures can be brought together in nearly their normal relation and, should subsequent pregnancy occur, dilatation of the perineum during labor is normally accomplished and the operative procedure is not a cause of dystocia. Where immediate repair has not been performed or has been attempted and failed, a secondary repair should not be undertaken too soon after labor. Four to six months should elapse, giving time for involution to take

place and the granulating areas to heal thoroughly. If done too soon the tissues are often soft and friable and do not lend themselves well to operative measures,



FIG. 6.—LACERATION OF PELVIC FLOOR INTO BOTH VAGINAL SULCI. Caruncle in center marks lower end of vaginal tab of uninjured mucous membrane.

and if they break down much valuable tissue is often lost and subsequent repair is rendered more difficult. This is especially true of lacerations through the sphincter, where the infection of the tissues usually resulting in the failure of primary repair makes it doubly important that they should be in healthy condition before a secondary operation is attempted.

The method that has given the best results in my hands has been based on the Emmet operation. The direction of the tear is studied in each case. The tissues beneath the lateral caruncles on either side that mark the edges of the tear are caught with forceps or suture and outward traction made so as to place the mucocutaneous border of the posterior vaginal wall on the stretch. The tab of injured vaginal mucous membrane between the sulci is now grasped at its lowest point with a Kocher forceps (this point is often marked by an isolated caruncle). The mucocutaneous border is now incised by scalpel or scissors between the lateral retracting sutures or forceps and upward traction is made on

the Kocher forceps (Fig. 7). The tissues are separated by blunt dissection and the scar tissue under the cicatrices on either sulcus is nicked with scissors. The finger is now easily pushed into the sulcus and by pressing upward on the vaginal wall the scar of the old laceration is easily outlined (Fig. 8). This tissue should be removed by cutting it away from the vaginal wall at its inner and outer margins. The amount of tissue removed will vary on the two sides (Fig. 9). With the excision of this scar tissue, the median vaginal tab is drawn further upward and inward, and the exposure of the sulci is complete. The fibers of the pubococcygeus can be easily felt and are often seen where the laceration is deep. The fascia of the urogenital trigone can be located and the resulting denudation is similar to that made by the original tear. The sutures are now placed in the same way as described in immediate repair operations (Fig. 10). One or two buried sutures approximate the deep sutures, the edges of the vaginal sulci are approximated by continuous or interrupted chromic catgut sutures (Fig. 11) and the skin wound is closed with deep sutures of silkworm-gut (Figs. 12 and 13).

COMPLETE TEAR

Where the laceration extends through the sphincter, certain preliminary treatment should be instituted prior to operation. The bowels should be thor-

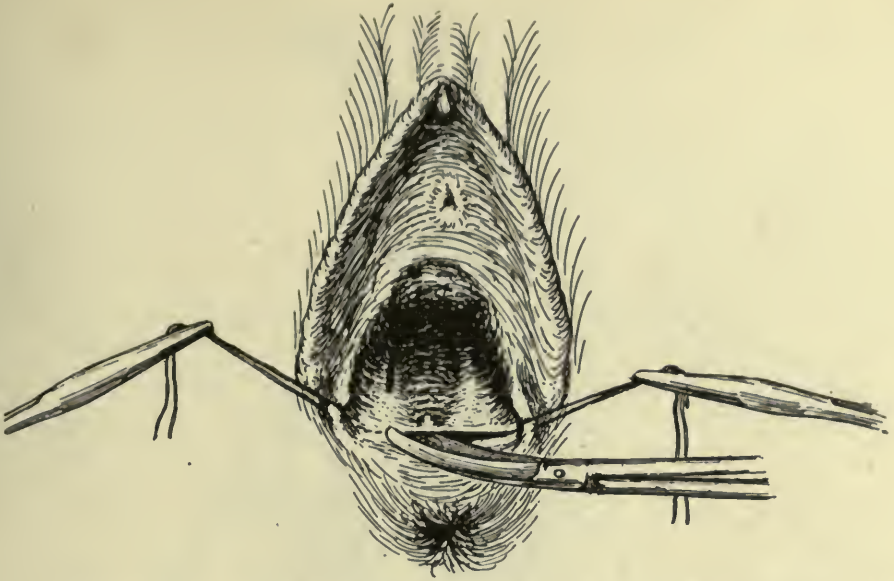


FIG. 7.—RETRACTION SUTURES IN PLACE AT LOWEST CARUNCLE ON EITHER SIDE. Mucocutaneous border being incised.

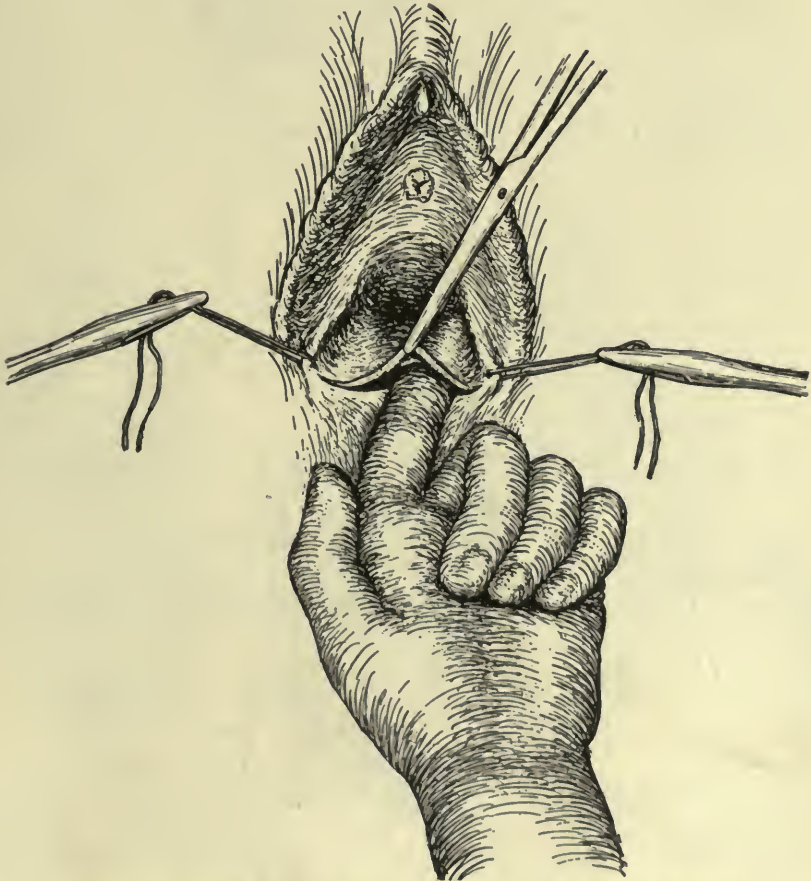


FIG. 8.—VAGINAL TAB LIFTED BY FORCEPS. Tissues in left sulcus being separated by finger and scar in vaginal wall exposed.

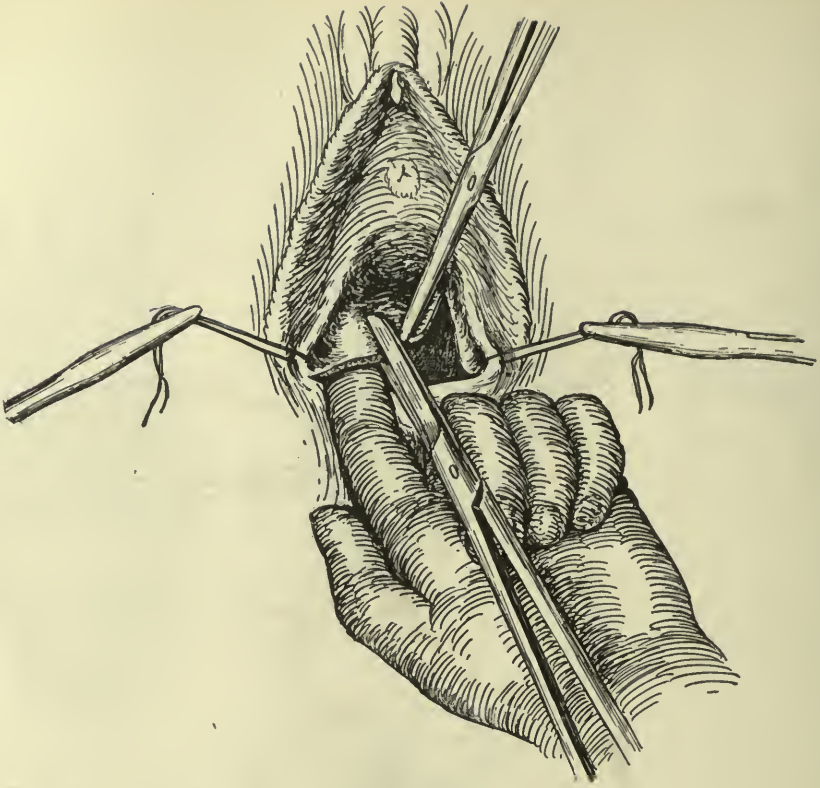


FIG. 9.—SCAR TISSUE ON LEFT SULCUS OF VAGINAL WALL EXCISED. Scar on right sulcus is exposed and being excised.



FIG. 10.—SCAR TISSUE ON BOTH SULCI REMOVED. Vaginal tab elevated. Deep sutures are in place. In actual practice the lower suture is tied before the upper one is introduced.

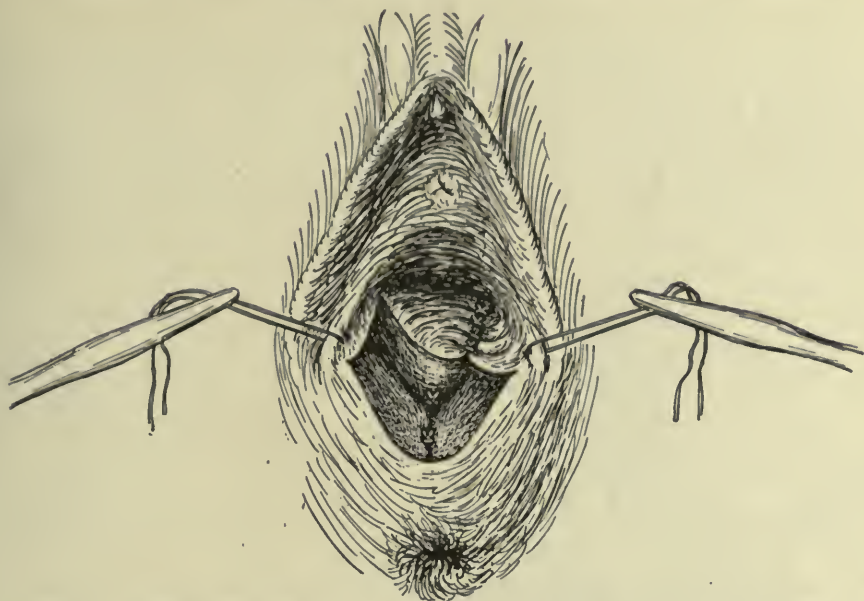


FIG. 11.—DEEP SUTURES TIED. Left sulcus is being closed by chromic sutures.

oroughly emptied with castor oil followed by high colon irrigation of normal salt solution 3 or 4 days beforehand. The diet should then be restricted as far as possible to broths and cooked cereals, with little or no milk or solid food. The colon washing should be repeated daily.

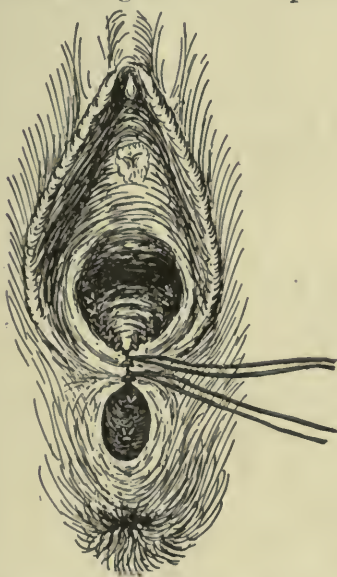


FIG. 12.—BOTH SULCI CLOSED. Silk-worm-gut sutures have closed the vaginal opening, the upper suture grasping the lower end of the vaginal tab.

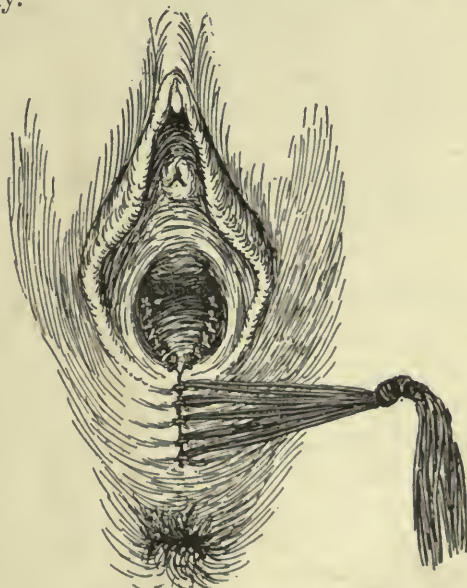


FIG. 13.—OPERATION COMPLETED. The external sutures pass deeply through the muscles supporting the buried sutures. Sutures are left long so that they can be easily removed.

After the patient is under the anesthetic and the external genitals and vagina are cleansed with soap and sterile water, the pits in the skin marking the retracted external sphincter are grasped with forceps and the fibers of the sphincter are stretched, the lower end of the rectum is irrigated with boric acid solution and a gauze pad to which a ligature is fastened is inserted into the rectum to prevent the rectal discharges from soiling the field of operation. The fascia and skin are now sterilized by tincture of iodine and alcohol. Traction by tenaculum forceps grasping the tissues at the lateral caruncles marking the edges of the vaginal tear now exposes the tear in the rectal wall. The union of the vaginal and rectal mucous membranes is divided by scalpel and the vaginal wall is separated from the rectum by blunt dissection; this separation is carried backward to the depressions in the skin marking the ends of the external sphincter and should extend laterally and inward far enough to allow easy approximation of the edges of the tear in the rectal wall, which is then brought together by interrupted sutures of fine chromic gut, care being taken not to include the rectal mucous membrane. The separation of the cicatricial tissue in the sulci is now completed, the median vaginal tab is caught with forceps and pulled upward and the scar tissue removed from the vaginal wall. The ends of the sphincter are now exposed and caught with tissue forceps and pulled upward and sutures are introduced on either side at right angles to the muscle fibers and tied about one-quarter of an inch behind the torn ends of the muscle. When these sutures are in place on either end of the sphincter they are brought together and tied approximating the torn ends. A second suture may be needed in some cases. The deep tissues are now brought together as in the immediate repair by buried sutures, efforts being made to draw the sphincter into relation with the levator and the torn edges of the posterior ends of the urogenital trigone. The skin is closed by interrupted silkworm-gut sutures, the ones nearer the anus passing deeply through the tissues external to the sphincter and including the fibers of the muscle. Under a boric acid douche the gauze pad in the rectum is withdrawn.

LACERATION ASSOCIATED WITH PROLAPSE OF THE POSTERIOR VAGINAL WALL AND RECTUM

Where the laceration of the pelvic floor is of long standing and the muscles have undergone more or less atrophy and the fascia has become stretched and thinned and there is prolapse of the posterior vaginal wall, the method of repair just described will fail. The separation of the tissues must be carried higher and deeper and the lost supporting power restored, as far as possible, by readjusting the structures and substituting a fixed point of support for the mobility and elasticity that normally exist. This is best brought about by interposing the 2 halves of the levator between the vagina and rectum by firm sutures and attaching the anterior end of the external sphincter as far forward as possible, the retracted posterior ends of the urogenital trigone being brought together in

front of the muscles. One point to be avoided is shortening the posterior vaginal wall which should be drawn as far forward as possible.

The patient is prepared for operation by the usual sterilization with alcohol and tincture of iodine. Operations on the uterus, cervix and anterior vaginal wall, that are necessary for associated conditions, are completed. The remains of the hymenal ring are grasped on either side $\frac{1}{4}$ to $\frac{1}{2}$ in. below the opening of the duct of Bartholini's

glands with tenaculum forceps and lateral traction is made. The mucocutaneous junction between the forceps is incised and the vaginal mucous membrane separated by blunt dissection. The mid-point of the cut edge of the vaginal wall is grasped with a Kocher forceps and drawn upward (Fig. 14). The dissection is carried upward between the vagina and rectum, being higher at the sides than in the median line, until the fibers of the levator ani are exposed on either side. Where the rectovaginal septum is thin this separation is often facilitated by introducing a pad anointed with vasc-

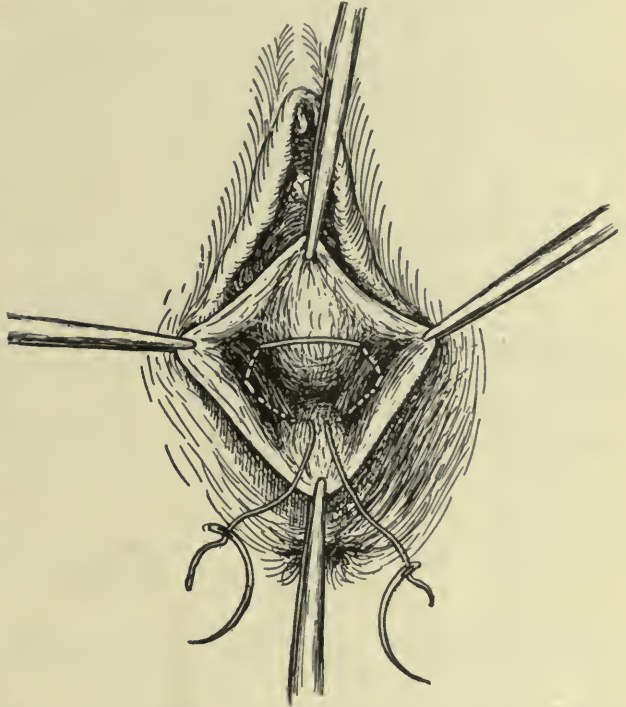


FIG. 14.—LEVATOR ANI MUSCLE EXPOSED ON EITHER SIDE. Suture of kangaroo tendon passes deeply through the muscles and grasps the tissues on the median line above the sphincter.

lin on a sponge-holder under the draperies, into the rectum. By pushing upward on this during the dissection the thickness and location of the rectal wall may be determined.

The levator ani being exposed, a suture of chromic gut or kangaroo tendon threaded at each end in full-curved round-pointed needles is passed deeply through the fibers on either side from behind forward and one end of the suture is passed through the tissues in the median line behind the sphincter. When this suture is tied it draws the halves of the levator together in the median line and draws the external sphincter upward and forward in relation to them (Figs. 14 and 15). A second or third suture may be placed in the same manner above the first, each suture grasping the halves of the levator a little further forward and pulling up the sphincter. When these sutures are placed it will often be found that the flap of vaginal wall has been well taken care of and can be closed

by suture. If it is too redundant, a small V-shaped piece can be excised and the cut edges brought together by continuous suture. The skin edges should be separated from the fascia of the urogenital trigone and the edges of the trigone should be brought together in the median line by interrupted catgut suture and the skin edges approximated by interrupted silkworm-gut sutures introduced deeply into the muscular structures.

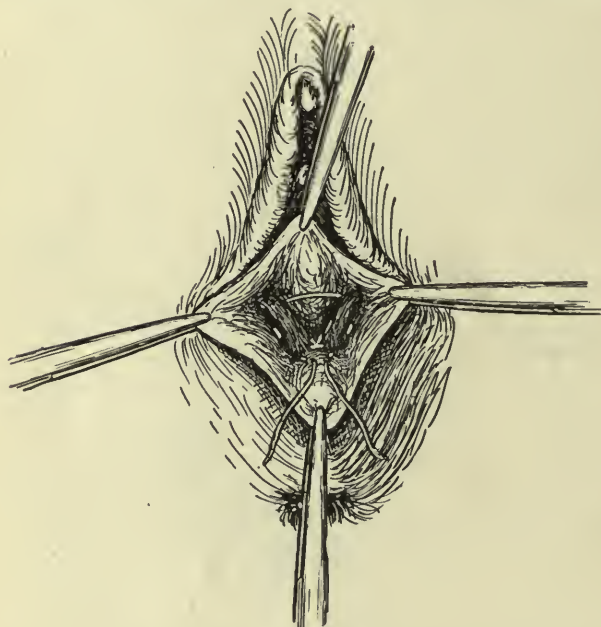


FIG. 15.—FIRST SUTURE TIED. Second suture through the levator and anterior end of sphincter in place.

There are several modifications of this procedure that may be necessary in certain cases. Where the prolapse of the rectum starts high up on the posterior vaginal wall, the separation between the vagina and rectum must be carried almost to the peritoneal pouch. The suggestion of Ward in these cases is often of service. After the separation of the vagina and rectum is completed, he introduces a chromic catgut suture through the posterior vaginal wall at the highest point of the separation. This is then passed transversely

through the rectal wall a little below the summit of the rectal protrusion and then back through the vaginal wall close to the point of entrance. When this suture is tied it pulls the prolapsed rectal wall upward. The 2 halves of the levator and the sphincter are then brought together and the operation completed by the method already described.

Where the rectal pouch is large and its walls very much thinned, G. H. Noble advises mobilizing the rectal wall by free separation from the vagina, dilating the external sphincter and pushing the rectal pouch down through the anus, where it is clamped and cut off, the edges being brought together by a through and through continuous suture, which can be reinforced by Lembert sutures on the vaginal side. The muscles are then brought together and the operation completed. Noble and Mayo report a number of cases successfully operated upon by this method.

The methods here given for pelvic floor repair are adapted to the majority of cases, modifications and combinations of the methods being necessary to meet individual conditions.

The after-care of cases operated upon for pelvic floor repair is important. The parts should be thoroughly protected by sterile gauze pads. The patient should be allowed to urinate voluntarily. Catheterization should be avoided if possible and when necessary the catheter should be dipped in a sterile 5 per cent. solution of argyrol before introducing it into the bladder. This will often prevent cystitis. After urination the parts should be irrigated with a solution of H_2O_2 in sterile water 1-4 and afterward with sterile water and the skin carefully dried. Vaginal douches are not usually needed and should be avoided if possible. The bowels should be moved on the third day by giving 1 to 2 oz. of castor oil followed 1 hour later by an enema of 6 ounces of olive oil. The bowels should be moved daily by an enema after the fifth day. In cases of laceration through the sphincter the diet should be restricted as much as possible for 4 days, when castor oil followed by an olive oil enema is given. The external sutures of silkworm-gut should not be removed before the eleventh or twelfth day, unless on inspection they are found to be cutting the tissues. The patient should not be allowed out of bed until the fourteenth day. The recumbent posture that minimizes intra-abdominal pressure is much more important after operations on the pelvic floor than after the majority of abdominal operations. When the patient is allowed to get up care should be taken to have proper abdominal support by corset or bandage, for vicious intra-abdominal pressure will in the course of time nullify the best operative result.

RECTOVAGINAL FISTULÆ

Fortunately the fistulæ of the vagina connected with either the rectum or bladder are today much more infrequent than they were in the past. The advance in obstetric surgery has eliminated the serious cases of pressure-necrosis that so frequently terminated in extensive openings between the vagina and rectum or bladder. On the other hand many fistulæ occur today as a result of operative procedures. The radical operations for carcinoma of the uterus, or the removal of intraligamentary and impacted fibroids or inflammatory conditions associated with dense adhesions may result in the accidental opening of either the bladder or rectum and the subsequent formation of fistulæ, often small in size but inaccessible for easy repair.

Rectovaginal fistulæ low down can best be repaired by freshening the edges of the fistulæ, separating the walls of the vagina from the walls of the rectum so as to mobilize the rectal wall and closing the opening into the bowel either longitudinally or transversely, in whichever direction the sutures can be placed with the least tension on the tissues. The sutures, of fine chromic gut, in the rectal wall should extend down to but not through the mucous membrane of the rectum and may be either continuous or interrupted, the first layer of sutures being reinforced by a continuous suture introduced by the Lembert method, so that the first line of sutures is covered over and buried. The edges

of the vaginal wall are now brought together by an interrupted catgut suture and it is advisable, if both rows of sutures are longitudinal, that they should not be superimposed. Small fistulæ just above the sphincter usually following an unsuccessful attempt at closure of a complete tear of the pelvic floor are best treated by dividing the tissues between the fistulæ and the anus and then closing the resulting wound by the same methods that are used for the repair of a laceration through the sphincter. In cases of fistulæ high up in the vaginal vault the success of the operation will depend upon the size of the fistula and the ease with which it can be reached. In such cases a longitudinal incision of the vaginal mucous membrane is made below the fistula. The vaginal walls are separated from the rectum. A suture may be placed through the rectal wall below the fistula for traction. It may be possible to mobilize the rectum sufficiently to expose the opening, freshen the edges and close it by suture. Eden has reported a case in which a fistula high up in the vault of the vagina had resisted several efforts to close it from below. He performed a preliminary inguinal colostomy which allowed him to cut off and disinfect the lower portion of the bowel. After a suitable interval the abdomen was opened, the peritoneum surrounding the upper end of the rectum was incised and the fistula was exposed and closed. The peritoneum was drawn over it, and a small drain was placed in the vagina. The wounds healed promptly and at a later date the continuity of the bowel was restored by closure of the colostomy.

VESICOVAGINAL FISTULÆ

The principle first emphasized by Mackenrodt of free separation of the bladder from the anterior vaginal wall before attempting to close the opening in the bladder governs operative procedure in this condition. The extent of this separation will depend upon the size and location of the fistula. When the fistula is small and easily exposed, the cicatricial tissue surrounding the opening is removed, and the tissue between the vagina and bladder is separated sufficiently to allow the closure of the opening without strain upon the suture line. The sutures are introduced through the muscular coat of the bladder, but not through the mucous membrane, so that when tightened the mucous membrane is turned into the bladder. Where the fistula is large and there is great loss of tissue, separation of the bladder from the vagina must be extensive, the dissection of the bladder extending on the anterior wall of the uterus up to the peritoneal fold if necessary. When the bladder has been mobilized the direction of suture must be governed by the ease with which the edges of the wound can be approximated either in the longitudinal transverse, or oblique, direction. Complete closure of the vaginal wound should not be attempted if too much tension is thereby placed on the sutures. The edges of the vagina may be stitched to the closed bladder and allowed to heal by granulation. Where the loss of tissue is so great that the bladder cannot be sufficiently

mobilized to bring the edges of the fistulæ together. Freund, Dudley and others report cases in which the cervix or uterine wall sutured to the edges of the opening in the bladder were used to close the fistulæ. Kelly reports a case in which the bladder was entirely freed from its uterine attachment and the fundus of the bladder was thus mobilized sufficiently to draw it down and close the fistula. When the fistula is high up in the vagina, usually the result of operative procedure, the same principle of free separation of the bladder from vagina will often permit closure of the opening. In these cases the posture of the patient may aid in the exposure. The use of either the Sims or knee-chest position, and in the presence of a rigid pelvic floor, the use of the Schuchardt paravaginal incisions will enable sufficient retraction to be made to render operative manipulation easier.

The separation of the bladder and vagina must often be begun just behind the base of the urethra (Fig. 16), carrying the separation upward by a longitudinal incision in the direction of the fistula. If sufficient mobility is not obtained in this way, a transverse incision on a line with the fistula may be made. A traction suture below the fistula may be placed through the vaginal wall and may aid in bringing the fistula within reach. Or a sound may be passed through the urethra as suggested by Ward (Fig. 17), used as a lever to push the bladder downward. When within reach the edges of the fistula are excised and closed with chromic gut and the incisions in the vaginal wall closed by interrupted sutures.

There are a number of cases in which operations through the vagina have failed owing to dense connective tissue, immobilizing the vault of the vagina, where a suprapubic operation has been successfully performed, the bladder being opened and the fistula closed from within the bladder.

In other cases the abdomen has been opened, carefully walling off the intestines, the adhesions broken up, the peritoneum over the bladder incised, and the bladder freed so that the fistula is exposed and closed.

Preliminary treatment of these cases in which there is marked irritation of the vagina is important to the success of the operation. The patient should be placed in bed, given frequent douches with boric acid solution, the bladder irrigated through the urethra with boric acid solution, the vagina freed from

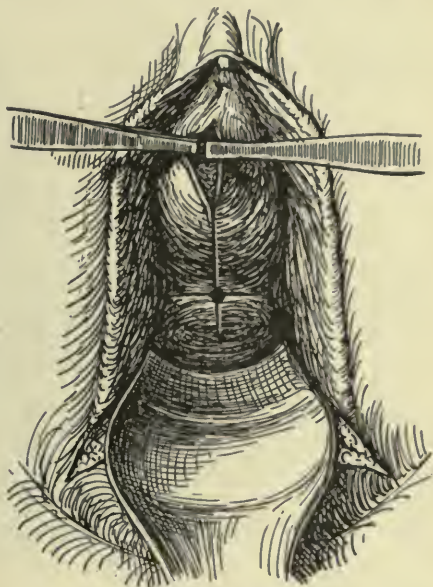


FIG. 16.—VESICOVAGINAL FISTULA HIGH UP IN VAULT OF VAGINA. Schuchardt paravaginal incision shown at sides of speculum. Longitudinal and transverse incisions of anterior vaginal wall indicated. Separation of vagina and bladder begun behind the urethra. (After Ward.)

all urinary deposits, application of a 2 to 5 per cent. solution of nitrate of silver made to ulcerated surfaces that may have developed, and the use of zinc oxid ointment to protect the skin and vagina from further irritation. In some cases the incrustation on the vagina may be so extensive that the use of an anesthetic is required to cleanse the vaginal canal. It may be necessary to repeat this procedure a number of times before the tissues are in suitable

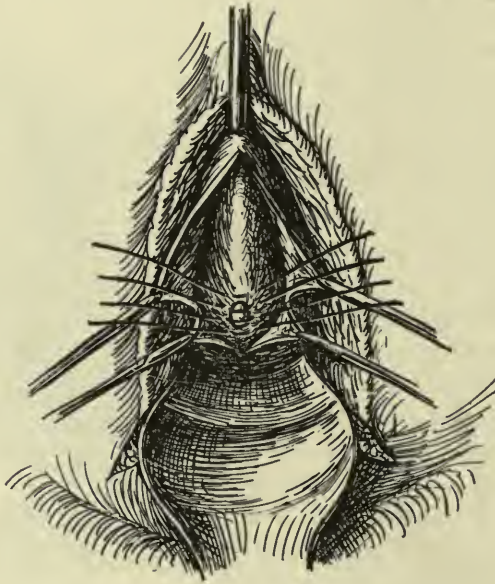


FIG. 17.—SEPARATION OF BLADDER AND VAGINA COMPLETED. Sound introduced through the urethra used to force the bladder into the wound and expose the fistula. Sutures for closing the fistula in place. (After Ward.)

condition for attempting to close the fistula. The use of frequent sitz-baths may be of service. The patient should be encouraged to drink water copiously and urinary antiseptics such as urotropin or salol may be of benefit.

In the after-care of these cases the bladder should be drained by means of a self-retaining catheter for 2 or 3 days or under strict asepsis the bladder should be catheterized every 2 or 3 hours. Urotropin should be administered until the wounds have healed.

INJURIES TO THE CERVIX UTERI

Lacerations of the cervix, while occasionally caused by careless or forcible operative procedures, are as a rule the result of labor. The tears may be single or multiple. As a rule they are confined to the portio vaginalis and are bilateral, often unequal in length on the two sides, sometimes extending to or through the cervicovaginal junction. While these lacerations, if slight, un-

doubtedly unite spontaneously, the majority of them, if extensive, heal by granulation and interfere with involution of the uterus. The cervix remains hypertrophied. If the laceration extends to or beyond the cervicovaginal junction the muscle fibers at the base of the broad ligament are involved, the mobility of the uterus may be interfered with and, if contracture of the muscle fibers takes place, may cause pelvic pain.

Many of these lacerations should be repaired immediately after labor or within 48 hours, when the edema of the tissues has subsided. A careful examination of the condition of the cervix should be made after labor. If a well-marked laceration exists and the tissues of the cervix are not too edematous the cervix should be exposed at the vulva by the aid of perineal retraction and the anterior and posterior lips of the cervix should be grasped by sponge-holders. **The use of pointed instruments is to be avoided because of the friable condition of the tissues at this time.** Twenty-day chromic gut sutures should be introduced deeply through the tissues of the cervix starting just below the angles of the tear, care being taken to make traction, on the forceps grasping the cervix, so that the edges of the tear are in apposition and there is no overriding of either the anterior or posterior lip. This point is important, for if overriding occurs, the lacerations heal badly, and may result in elongation of one of the lips of the cervix, requiring subsequent operation. If the tissue is very edematous and the laceration is severe, unless sutures are needed to control hemorrhage, it is advisable to wait 48 hours until some of the swelling has subsided and the edges of the laceration can be approximated and sutured. Operations at this time must be undertaken with competent assistants at hand and all due regard to asepsis, as carelessness of technic will surely lead to infection.

Where these lacerations have not been repaired at the time of their occurrence, or have failed to unite, they often cause no immediate symptoms and are neglected until repeated abortions lead to their disclosure as a causative factor, or pronounced leukorrheal discharge or pain demands treatment. Where there is slight enlargement or elongation of the cervix and the tissues are normal, with little or no erosion or eversion of the cervical mucous membrane, a trachelorrhaphy, as originally devised by Emmet, will meet the indication.

OPERATION OF TRACHELORRHAPHY

Under a general anesthetic, the external genitals and vagina are cleansed by soap and sterile water and thoroughly dried, and then sterilized with tincture of iodine and alcohol. The perineum having been retracted, the anterior lip of the cervix is grasped with bullet forceps and exposed. The cervical canal is thoroughly dilated. Care must be exercised in cases where the laceration is extensive that too great pressure is not made on the dilator as the scar tissue may give way. This is especially true in cases in which involution of the uterus is not thoroughly established and the tissues are friable. The

uterus is now curetted, especial attention being paid to the mucous membrane of the cervical canal. The interior of the uterus is wiped with gauze saturated with tincture of iodine and alcohol. The posterior lip of the cervix is then grasped by tenaculum forceps and the edges of the two lips of the cervix are approximated. This procedure is important as it enables the operator to estimate more carefully the extent of the tears, the length of the cervix, and to decide the question as to the advisability of employing a simple trachelorrhaphy, or trachelorrhaphy combined with partial amputation. For if the cervix is much elongated, the bringing together by sutures of the denudations necessary to repair the laceration may lead to such constriction of the cervical canal as to cause obstruction to uterine drainage when healed.

If trachelorrhaphy is decided upon the lacerations are exposed by separation and traction on the forceps attached to the anterior and posterior lips. The edges of the mucous membrane of the cervical canal involved in the lacerations are outlined by a scalpel. In a similar manner the edges of the vaginal mucous membrane of the cervix are outlined, the incisions on the anterior and posterior lip meeting at the inner and outer ends of the angle of the scar made at the junction of the anterior and posterior lip. The tissue between these two incisions is now removed by scissors or scalpel, care being taken to remove all the tissue at the angle. The success of the operation often depends on the thoroughness with which this tissue is removed. The lacerations being denuded, sutures of 30-day chromic gut are now introduced. The first suture should be placed just below the angle of the tear starting from the vaginal mucous membrane of the cervix through the muscular tissue and emerging just at the edge of the mucous membrane of the cervical canal and then through the edge of the mucous membrane of the canal on the opposite lip through the muscular tissue and emerging from the vaginal mucous membrane of the cervix opposite the point of introduction. Additional sutures are introduced in a similar manner $\frac{1}{8}$ in. apart, until the external os is reached. The sutures should not be tied until all are in place. The approximation of the edges of the wounds are facilitated by bringing the tenaculum forceps attached to the anterior and posterior lips together. Care should be taken in tying the sutures not to cause too much tension. Otherwise they may cause strangulation of the tissues and cut through. After the operation is completed a dilator, or a uterine sound, should be passed through the cervical canal to be sure that it has not been occluded by any of the sutures.

If the cervix is long and simple trachelorrhaphy would possibly cause future constriction of the cervix, the denudation may be made as previously indicated and a portion of the anterior and posterior lips may be removed sufficient to shorten the cervix and prevent constriction of the canal. This is easily accomplished after the lacerations are denuded and one or two sutures have been placed at the angles of the tears and drawn together but not tied. Portions of the anterior and posterior lips can then be removed. A transverse incision

is made in the cervical mucous membrane at a point at which the lip is to be amputated and an incision made through the mucous membrane of the cervical canal at a point opposite and a wedge-shaped piece of the lip removed. The edges of the mucous membrane of the cervix and the cervical canal are approximated by one or two chromic-gut sutures. After this has been done to both lips the edges of the laceration are closed by tying the sutures already in place.

In cases in which multiple lacerations make trachelorrhaphy impossible or the cervix is much enlarged, and there is an eversion or erosion of the cervical mucous membrane, or when the supravaginal portion of the cervix is elongated, as it frequently is in cases of prolapse, amputation of the cervix should be performed.

The ultimate result of this operation may often be improved if these cases undergo preliminary treatment for 2 or 3 weeks. Applications of tincture of iodine or silver nitrate to the eroded mucous membrane, the puncture of cysts of the cervix, the cavities being cauterized with equal parts of tincture of iodine and carbolic acid, or by the point of an electric cautery and the use of tampons and hot douches will often reduce the size of the cervix and of the uterus and render the tissues more suitable for operative procedure. Repair of injuries should never be attempted in the presence of an acute infection of either the vagina or uterus.

AMPUTATION OF THE CERVIX

The cervix is exposed and drawn down by tenaculum forceps, the cervical canal is dilated and the uterus thoroughly curetted (the condition is often associated with chronic endometritis) and wiped out with tincture of iodine and alcohol. The passage of the curet to the cornua of the cavity of the uterus gives a true indication of the size of the uterus and the length of the cervix, and thus indicates the extent of the amputation necessary. As a general rule the amputation should not extend higher than $\frac{1}{2}$ in. below the internal os, and it must be remembered that with the removal of even a small portion of the cervix, there is marked shrinkage of the entire uterus afterward, and in cases in which pregnancy is a possibility especial care must be exercised, for if the cervix is shortened too much it may interfere with the ability of the uterus to carry the pregnancy to term, or if contraction follows may interfere with labor.

An incision is made about $\frac{1}{4}$ in. below the cervicovaginal junction and encircles the cervix. If old lacerations exist this incision should pass well above the external margins of the scar. The mucous membrane is now pushed away from the muscular tissue of the cervix by the handle of the scalpel or gauze pad (Fig. 18), the separation being carried higher on the anterior and posterior surfaces than on the sides and a little beyond the point at which the amputation is to be made. The cervix is now split bilaterally and tension is made on the resulting anterior and posterior lips (Fig. 19). The posterior lip is now excised by severing its attachment to the

cervix by anterior and posterior incisions as indicated in Figure 19. The resulting wound in the cervix is deeper in the center and the sloping edges leave the mucous membrane of the canal long enough to be easily approximated to the mucous membrane covering the cervical stump. Two sutures of 30-day chromic gut are now placed as indicated in Figure 20. They are passed through the mucous membrane of the cervical canal and include some of the

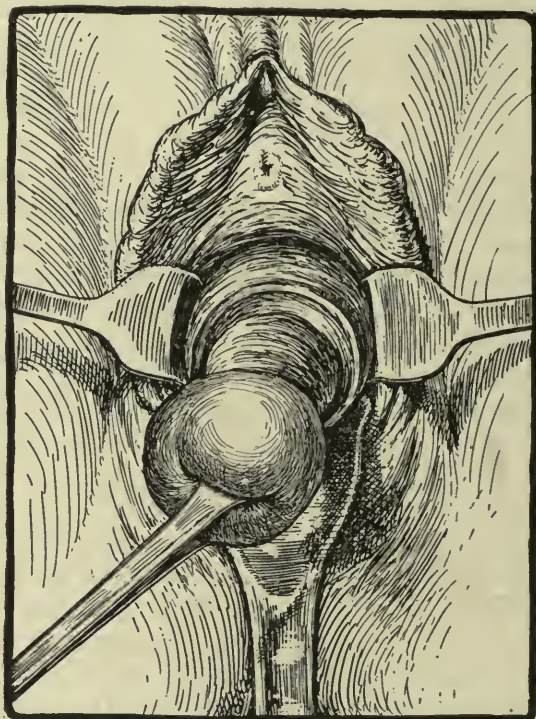


FIG. 18.—CERVICOVAGINAL MUCOUS MEMBRANE INCISED AND PUSHED UPWARD.

underlying muscular tissue, the center of the wound is skipped and then through the posterior edges of the muscular tissues and out through the cervicovaginal mucous membrane. The edges of the mucous membrane are carefully approximated, the sutures tied and left long so that when grasped by forceps they can be used for traction while the anterior lip is being amputated. This is accomplished by the same method of anterior and posterior incisions and the anterior mucous membrane of the cervical canal is sutured to the vaginal mucous membrane as shown in Figure 20. Traction is now made on the anterior and posterior sutures and the lateral angles of the wound are exposed. Some of the vaginal branches of the uterine arteries are cut and may cause troublesome bleeding. They are usually found at the lateral angles of the wound and should be caught by clamp and ligated. The lateral wounds are closed by sutures that pass deeply through the muscular tissue of the cervix as indicated in Figure 21. Except the sutures nearest the cervical canal, these

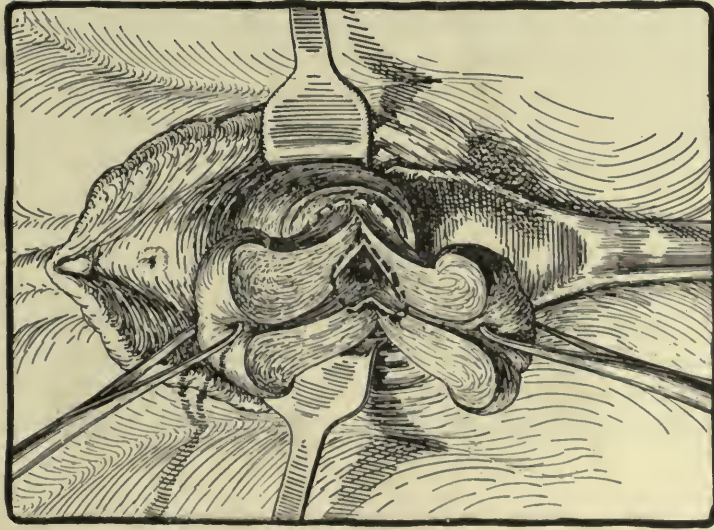


Fig. 19.—CERVIX BISECTED. Dotted lines show the incisions made for amputating the anterior and posterior lips.

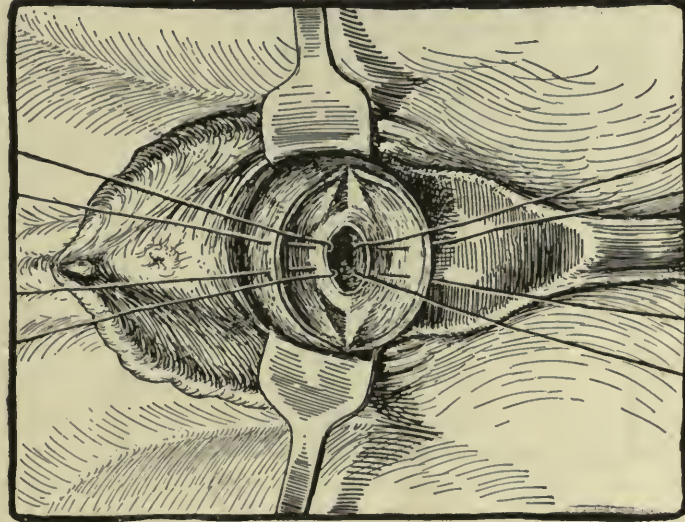


Fig. 20.—SUTURES DRAWING TOGETHER THE MUCOUS MEMBRANE OF THE CERVICAL CANAL AND THE ANTERIOR AND POSTERIOR CERVICOVAGINAL MUCOUS MEMBRANE IN PLACE.

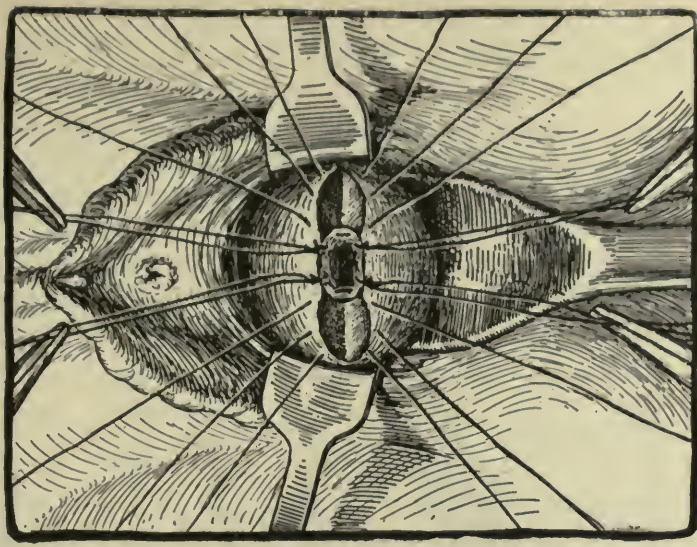


Fig. 21.—ANTERIOR AND POSTERIOR SUTURES TIED. Sutures for closing the lateral angles in place. Note the sutures on either side of the cervical canal.

are introduced so that after passing through the mucous membrane and muscular tissue of one lip they emerge in the cervical canal and are then reintroduced through the muscular tissue and mucous membrane of the opposite lip (Figs. 21 and 22). These sutures, described by C. P. Noble, are of great value in approximating the lateral edges of the cervical canal to the vaginal mucous membrane. The sutures at the lateral angles, when tied, control the bleeding, but should not be tied too tightly, otherwise strangulation of some of

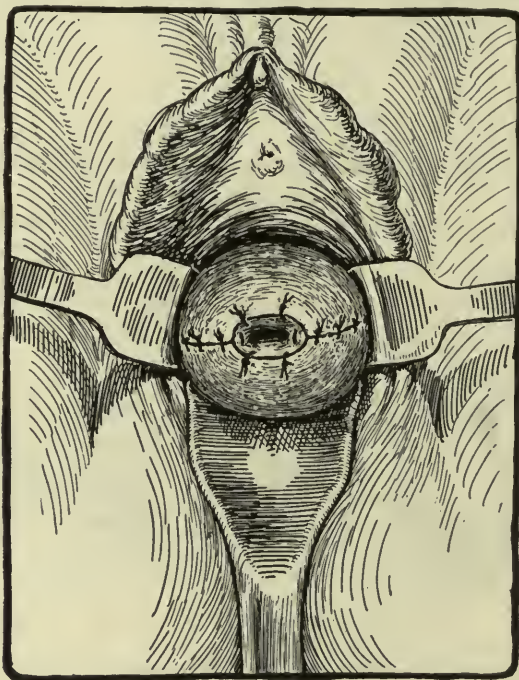


FIG. 22.—OPERATION COMPLETED.

the tissues may result. Care should be taken to ligate the open vessels at the lateral angles, for cases of severe secondary hemorrhage are on record in which this procedure was neglected and the deep sutures alone were depended upon for hemostasis. All tissues removed from the cervix should be submitted to careful pathological examination. The importance of this increases with the age of the patient. Early carcinoma may be found that can be cured by operation.

VAGINISMUS

From the character of the muscular spasm vaginismus is in my opinion due to irritability, or unusual development of the involuntary muscle fibers lying between the two halves of the levator ani. These cases are as a rule only relieved by operative treatment. Under general anesthesia the lower half of

the hymen is excised and an incision from $\frac{1}{4}$ to $\frac{1}{2}$ in. in length is made through the vaginal wall on either side at the location of the vaginal sulci. This incision should extend through the vaginal wall and the muscle fibers beneath it should be nicked. The outlet of the vagina is then stretched by the introduction of two fingers. The edges of the wound caused by the excision of the hymen are brought together by interrupted catgut sutures, approximating the edges so that the incisions at the angles are obliterated.

ATRESIA OF THE VAGINA

Congenital atresia of the vagina is not as a rule diagnosticated until the menstrual function has been established. The symptoms develop as a result of the retention of the secretion, or the non-appearance of the flow at the time of or after the age of puberty. This leads to an examination of the genital organs.

The simplest form of atresia is that caused by an imperforate hymen. The condition is easily relieved. Under general anesthesia, with careful regard for asepsis, crucial incisions are made in the obstructing membrane and the retained menstrual blood is evacuated. Care should be taken in the use of douches with these cases, as the uterus and tubes may be distended by the retained secretion and are easily infected. If the hymenal membrane is thin these incisions will usually suffice. If, however, it is very much thickened, the greater portion of it, especially that attached to the posterior vaginal wall, should be excised, after which the inner and outer edges of the incision should be brought together by sutures of fine chromic gut.

Where the atresia is higher up and consists of a comparatively thin diaphragm obstructing the vaginal canal, the portion of the canal above the obstruction being distended with retained menstrual fluid that fluctuates on palpation, the following procedure is advisable. The obstructing diaphragm is punctured at the vault of the lower segment of the vagina at the point of greatest fluctuation, and the retained fluid evacuated. The opening is enlarged enough to permit thorough examination of the upper portion of the vagina. The tissues at the point of obstruction are now excised and stretched and the edges of the vaginal wall of the upper and lower segments are separated throughout their circumference from the underlying tissues sufficiently to permit the approximation of the edges. The edges are then brought together by interrupted catgut sutures.

Where the greater part of the vaginal canal is closed by a wide band of tissue and the menstrual function is evidenced by abdominal pain, and the appearance of a tumor caused by the distended uterus, palpable either through the abdomen or rectum, greater difficulties in operative procedure are met with. The older methods of attempting to bore through the tissues between the lower end of the vagina and the uterus by blunt dissection were followed by such serious immediate results and subsequent failure to relieve the condition that

they have been discarded. Since Pfannenstiel reported his first successful operation in a case of this kind after opening the abdomen and determining the exact condition of the organs, this method has been the one of election. In all cases in which there is marked atresia of the vagina, whether affecting the lower, middle or upper portions, the uterus and appendages should be examined through the abdomen. The distended uterus should be opened by an incision through its anterior wall, the contents evacuated and the condition of the tubes and ovaries determined.

Where the uterus and its appendages are normal, efforts should be made to construct a vaginal canal. Should their condition, however, not warrant this procedure, hysterectomy with the retention of one or both ovaries is advisable. If they are normal, the bladder should be separated from the anterior uterine wall, the dissection carried downward as far as possible and the extent of the upper vaginal pouch connected with the cervix determined. The anterior vaginal wall may be opened and the cavity explored. The tissues between the vagina and rectum are now separated from below, the direction of the dissection being guided by the hand of an assistant in the abdomen. Pfannenstiel was able by this procedure to loosen the attachments of the cervix from above and draw it down and attach it to a short rudimentary vagina. The result of the operation was not only successful so far as the menstrual function was concerned but the vagina afterward became lengthened by the retraction of the uterus. Since the report of his original case, many others are on record in which the same method of procedure has been followed. Undoubtedly the separation of the bladder in many of these cases would be facilitated by a preliminary catheterization of the ureters, the catheters being left in place during the operation.

Where there is entire absence of the vagina with absence of the uterus and ovaries, or where these organs are merely rudimentary and there is no evidence of a menstrual molimen, another question comes up for consideration. In some cases this condition is undoubtedly one of cryptorchidism with feminine physical characteristics and any operative procedure is inadvisable. In other cases without discussing the ethical side of the question, it is debatable whether the surgeon is justified in attempting to construct a vagina simply for the purpose of sexual intercourse. The older plans of treatment for this condition by dissection of the tissues between the bladder and rectum and attempting to construct a vagina by various methods of tissue implantation or transplantation were, as a rule, unsuccessful, as the canal contracted within a short time. The operations were associated with greater risk than the ultimate results warranted.

The most successful method so far devised for the construction of a new vagina is that devised by Baldwin, by which the canal is constructed from a segment of the intestine. The operation is of necessity a severe one and must have for its justification unusual circumstances. Munro Kerr reports a successful case operated upon by Baldwin's method. The report of this

case gives the details of the operation together with a very excellent reason for which it was undertaken:

"The woman was thirty years of age and married. She was to all appearances physically well developed. She was of normal height, well nourished, had well-developed mammae and vulva. There was, however, only the shallowest dimple, marking the vaginal entrance. I detected by a recto-abdominal examination made under anesthesia that there were two movable bodies (ovaries) placed close up against the pelvic brim. I could find no trace of a uterus. She had no discomforts in the way of menstrual molimen, abdominal pain or headache; indeed, she enjoyed perfect health. She informed me, however, that her husband threatened divorce. I explained to her the operation which I ultimately performed, and she decided to have it done. The operation was performed as follows: I opened the abdomen and isolated the most dependent loop of ileum. It was situated about a foot from the ileocecal valve. Having done this and closed up the ends of the isolated loop, I established a lateral anastomosis between the ileum and cecum. I now turned my attention to the perineum and dissected up between bladder and rectum. This was a matter of considerable difficulty, as there seemed to be singularly little loose cellular tissue between these two viscera. Ultimately I established an opening into the peritoneum and pulled down the loop of isolated bowel. I tried to bring one end down, but found that impossible, although I now believe with proper snipping of the mesentery it might not be so very difficult. I had, therefore, to bring down the loops doubled up. I then stitched it to the margin of the perineal wound. Two or three days later I opened into the lumen of the bowel. The patient made an excellent recovery and some months after the vagina was of good depth and admitted one finger. I have not seen her for three months. She did not complain of any mucous discharge."

In the majority of reported cases operated upon by this method, some 15 in number, the continuity of the intestine has been reestablished by lateral anastomosis. In many it was not found necessary to divide the septum of the vaginal loop as retraction gradually occurred. In some cases an annoying discharge from the canal persisted for some time.

Acquired Atresia.—Acquired atresia of the vagina is due usually to inflammatory or traumatic causes and operative procedures must of necessity be based on the location and extent of the cicatricial tissue. So far as possible without injury to adjacent organs this cicatricial tissue should be removed and the plan of treatment adapted to the individual case. Often the result at best can only be the opening of a canal for the drainage of the uterine discharges. In many cases hysterectomy must be performed.

Atresia of the Cervix.—Where atresia of the cervical canal is limited to the tissues near or at the external os, the distended canal may be punctured by a trocar and the hematometra relieved. The edges of the external os are excised and the mucous membrane of the cervical canal attached to the mucous membrane of the cervix. Where the atresia extends through the length of the canal or involves the internal os, puncture by trocar is inadvisable. The abdomen should be opened and the condition of the uterus determined. Gouliond reports a case in which after opening the abdomen the anterior wall of the uterus was opened, its contents evacuated and the obstruction at the internal os located. The bladder was then separated from the uterus and the incision

in the anterior uterine wall extended through the obstructing tissue (Fig. 23). A wedge of tissue was removed at the site of obstruction and the mucous membrane of the cervical canal united with the mucous membrane of the cavity of the uterus. A gauze drain was passed through the external os and the opening in the anterior wall of the uterus closed. The result was good and there was no return of the obstruction.

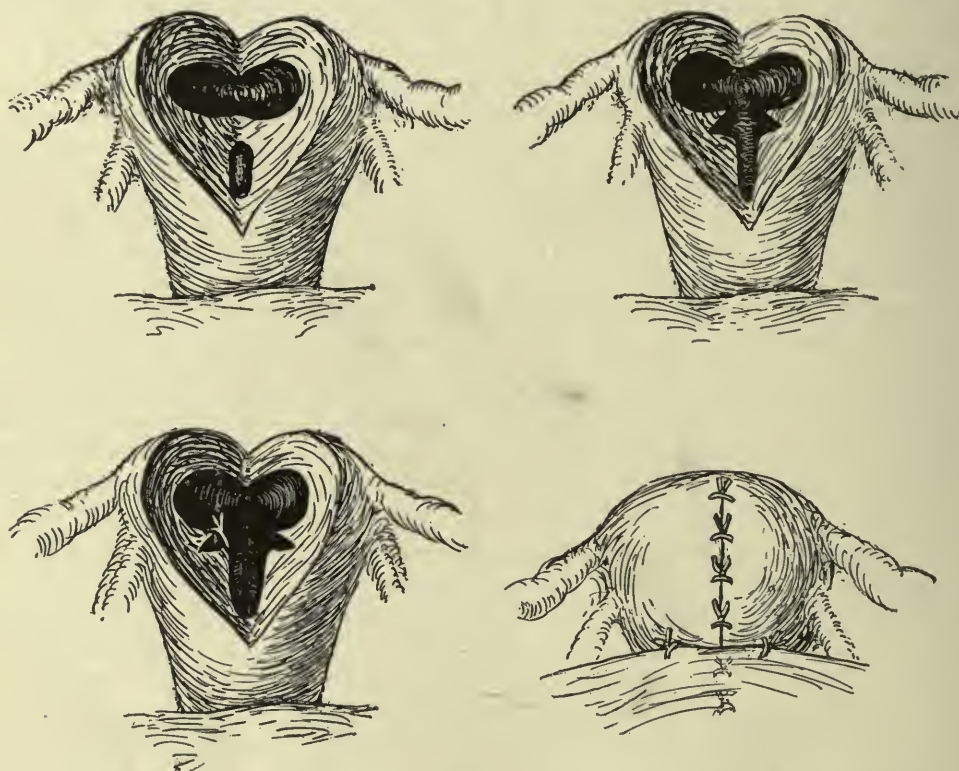


FIG. 23.—ATRESIA OF CERVICAL CANAL AT INTERNAL OS. Uterus opened through the anterior wall. Wedge-shaped piece excised at internal os. Endometrium sutured to cervical mucous membrane. Uterus closed. (After Goullioud.)

In cases of double vagina division of the septum is often sufficient. The entire septum, however, may be excised without difficulty, the incision of the anterior and posterior walls being closed by sutures of fine chromic catgut. The congenital deformities of the uterus do not as a rule call for operative treatment unless there are definite symptoms that can be charged to the condition. Dysmenorrhea due to rudimentary horn of the uterus may be relieved by its excision. Munro Kerr reports a successful case of this kind. A partial or complete septum existing in an otherwise normal uterus may call for operative procedure when it is the cause of persistent abortion. Through the abdomen the uterus is opened and the septum excised. The 2 halves of the uterus being brought together by the suture, care being taken to unite the edges of the endometrium.

CHAPTER XI

OPERATIVE AND NON-OPERATIVE TREATMENT OF DISEASES OF THE TUBES AND OVARIES, INCLUDING INFLAMMATIONS, TUBERCULOSIS, NEW GROWTHS AND EXTRA-UTERINE PREGNANCY

GEORGE GRAY WARD, JR.

DISEASES OF THE FALLOPIAN TUBES

I. MALFORMATIONS AND DISPLACEMENTS

Absence of the tubes occurs in conjunction with defects in the development of the uterus. Persistence of the fetal type, accessory tubes, or tubal ostia and diverticula are occasionally encountered. Their surgical interest is that they may be a cause of ectopic pregnancy. The tube has been found in a hernial sac, and 3 cases have been reported of pregnancy occurring in a herniated tube.

II. INFECTIONS

Salpingitis is caused by infection with micro-organisms, and may be classified as: (1) gonorrheal; (2) pyogenic, the organisms being usually the staphylococcus or streptococcus and, less frequently, the colon bacillus, pneumococcus, anaërobic bacilli, actinomycosis, and the spirocheta pallida of syphilis; (3) tuberculous.

A. ACUTE SALPINGITIS

A. Gonorrheal Variety.—The gonorrheal variety of salpingitis is by far the most frequent type of infection. Probably 75 to 85 per cent. of all pus tubes that come to operation are of gonorrheal origin, if we add to the cases where the gonococcus has been demonstrated those pus tubes in which the pus is found to be sterile, as commonly occurs in chronic gonorrheal salpingitis. When the number of cases of absolute and one-child sterility are also taken into consideration, the importance of gonorrheal infection as a factor in the destruction of the female genital tract and in the unhappiness of women may be realized.

While the gonococcus was discovered by Neisser in 1879, Noeggerrath, 7 years earlier, in a monograph which is today a classic, gave a masterly descrip-

tion of the clinical course of the disease in women. So clear an insight had he into the far-reaching destructiveness of the disease and the great difficulty of its eradication, that his views remain true today with but few modifications.

Gonorrheal salpingitis occurs by extension from infection of the external genitals or of the cervix. The tendency of the disease is to remain as a localized process in these parts, unless the bodily resistance is lowered—as after a menstrual period of unusual severity or late in the puerperium after a labor when the pelvic organs are congested—or as a result of mechanical interference—as in attempts to treat the disease in the cervical canal by local measures. The infection then passes beyond the barrier of the internal os, and rapidly extends by continuity of the mucous membrane to the mucosa of the fallopian tubes. Early in the infection of the tubes, the abdominal ostia are closed, and the walls become congested, thickened, and tortuous, and—as the inflammation involves the peritoneal covering—a plastic exudate is thrown out and they become adherent to the surrounding tissues.

The infection may remain localized as a pyosalpinx with the ovary adherent to it, but without its deeper tissues being involved; or it may spread to a follicle or cyst of the ovary, producing suppuration of its contents and destruction of the ovarian stroma, thus forming a tubo-ovarian abscess.

B. Pyogenic Variety.—The most frequent type of this variety is caused by the staphylococcus and the streptococcus.

The inflammation usually begins abruptly from an infection following an abortion or operative delivery, or after intra-uterine manipulations. The infection travels by the blood-vessels and lymphatics of the broad ligaments and not by continuity of the mucous membrane, as in a gonorrheal salpingitis; consequently it is more common to find a resulting pelvic cellulitis or ovarian abscess than a pyosalpinx in these cases. Although the infection is more severe in its course and more dangerous to life, on account of the frequency of the development of general peritonitis and septicemia, the destruction of the tube and ovary is not so great as in salpingo-oöphoritis of gonorrheal origin.

C. Tuberculous Variety.—Tuberculous salpingitis is usually secondary to tuberculosis elsewhere, but it may be primary in its origin, as Williams, who has contributed a careful study of the subject, found in numerous instances. While the disease is usually found to be unilateral clinically, a microscopical examination frequently shows that the other tube, although of normal appearance, is also involved. Williams states that 8 to 10 per cent. of the appendages removed for inflammatory diseases are of tuberculous origin but only 25 per cent. of these can be recognized microscopically.

In the early stages it is difficult to distinguish tuberculous from catarrhal salpingitis, but later the presence of numerous small gray miliary tubercles studding the surface of the tube, the gray-red, water-logged, friable tissues, and the open abdominal ostium and cheesy contents make the diagnosis a simple one. The ovary is usually resistant to tuberculosis but may be involved secondarily by extension from the tube. The intestines and parietal peritoneum

are also frequently involved, and the affected tissues may be so massed together as to be indistinguishable. Ascites, either encysted or free, is apt to be present.

Pus tubes may rupture into the adjacent organs, as the intestine, bladder, vagina, or through the abdominal wall, although they rarely do so if of gonorrheal origin.

B. CHRONIC SALPINGITIS

The chief characteristic of gonorrheal inflammation is its chronicity, while inflammations produced by the pyogenic organisms, if they do not destroy life, tend to subside.

Tuberculosis of the tubes, while it may become suppurative in the chronic form, also has a tendency to cicatrize. Gonorrheal infection, on the contrary, not only remains a constant source of ill-health to the patient, but it prepares the soil for subsequent infection by the tubercle bacillus or the pyogenic organisms. As Norris states, tubal carcinoma seldom occurs in previously normal tubes, and the loss of cilia from the tubal epithelium or kinks of the tube—which are the result of adhesions—and the alteration of the tube in salpingitis isthmica nodosa are known to be strong predisposing factors to tubal pregnancy.

In the chronic form of pyosalpinx which remains after an acute process, the tube is clubbed and dilated, and contains purulent material which, if of long standing, may be sterile. It is covered with plastic adhesions which envelop the ovary and bind the whole mass to the posterior surface of the broad ligament and the uterus, as well as to the walls of the pelvis. Before the pus has become entirely sterile, repeated acute attacks may follow upon the chronic quiescent stage at irregular intervals, as a result of trauma or intra-uterine treatment. With each acute attack of pelvic peritonitis more plastic exudate is thrown out, which results in increasing the amount of adhesions already present. By the gradual conversion of its sterile contents into a serous fluid, an old pyosalpinx may become a hydrosalpinx, although, as a rule, hydrosalpinx is of puerperal origin.

III. NEOPLASMS OF THE TUBE

Neoplasms of the tube are very rare, but primary carcinoma is occasionally encountered. Norris reports a case and found 86 cases in the literature that were unquestioned. Carcinoma that is secondary to uterine cancer is of more frequent occurrence. The other neoplasms found are the polypoid growths developing from the mucosa, papilloma, chorio-epithelioma, sarcoma, and—very rarely—myoma.

IV. TREATMENT

A. ACUTE SALPINGITIS (INCLUDING ASSOCIATED OÖPHORITIS)

A. Non-operative Treatment.—It is a well-established fact that operative treatment is contra-indicated during the acute stages of salpingitis or oöphoritis,

except in cases where it is necessary to evacuate pus which is endangering the life of the patient.

Thaler reviewed 6,179 cases of pelvic inflammatory diseases in Schauta's clinic, and his findings confirm this statement beyond question. The non-operative treatment in all acute cases should consist of absolute rest in bed in the Fowler position. This is most satisfactorily accomplished by the use of a Gatch frame, which is placed under the mattress and which can be adjusted to elevate the shoulders and the knees of the patient, so that she assumes the same attitude as if she were sitting in a steamer chair. An ice-coil or bag should be placed over the lower abdomen and frequent cold vaginal irrigations should be employed. Morphin, sufficient to control the pain, should be given hypodermically, if necessary, but opium or codein suppositories may answer. The patient should be given a liquid or soft diet, and the bowels should be moved with mild cathartics. Care should be taken to make as infrequent vaginal examinations as possible. In severe cases, the enteroclysis method of Murphy should be employed. Vaccine therapy, while some brilliant results have been attained by its use, has, on the whole, been so uncertain as to be disappointing. Autogenous vaccines should be employed whenever possible, if this treatment is resorted to.

B. Operative Treatment.—VAGINAL ROUTE.—If pus forms in sufficient quantity to give evidence of its presence by bulging in the vaginal fornices and symptoms of absorption develop, it should be promptly evacuated through the vagina by a posterior colpotomy, and ample drainage should be provided for (see *Technic in Operative Gynecology*, Chap. IX). Great care should be taken after opening into the abscess cavity not to disturb its walls or the adhesions shutting it off from the abdominal cavity above, and, if irrigation is employed, it should be done under very low pressure. A double rubber drainage tube of large caliber, sutured in its position, maintains more perfect drainage than gauze. In certain instances the pus may point in the inguinal region, and, in such cases, it may be evacuated by a simple incision in that location.

It occasionally happens that a mass develops in this same region which evidently contains pus that should be evacuated but which cannot be reached with a simple incision. In such a case, the abdominal wall may be opened in the inguinal region until the peritoneum is encountered. Care should be exercised not to open the peritoneum but to push it aside by blunt dissection until the mass can be reached. It is then opened extraperitoneally.

A rupture or torsion of an inflamed appendage, or the development of a general peritonitis, may justify an abdominal section during the acute stage. The vaginal route is so much safer that it is the method of choice in practically all cases of pelvic abscess. Noble gives the mortality statistics as 27 per cent. for the abdominal route as compared to less than 2 per cent. for vaginal incision and drainage. While it may be necessary at some later time to subject the patient to an abdominal section for the relief of adherent structures which pro-

duce troublesome symptoms, the desirability of the vaginal operation far outweighs this possibility.

The many advantages of the vaginal route have been summarized by Kelly as follows: (1) greatly diminished mortality; (2) preservation of structures; (3) restitution in many instances to normal condition, including menstruation and pregnancy; (4) avoidance of complications, such as injury to adherent structures; (5) a much easier convalescence, with less suffering; (6) no risk of postoperative hernia; (7) feasibility when the patient is too ill to survive an abdominal operation.

B. CHRONIC SALPINGITIS (INCLUDING ASSOCIATED OÖPHORITIS AND NEOPLASMS)

A. Non-operative Treatment.—While non-operative treatment of chronic inflammatory diseases of the tubes and ovaries is, as a rule, unsatisfactory in affording any permanent measure of relief of symptoms, the operative procedure, with few exceptions, will be made easier and safer, and the organs will be more amenable to conservatism if they are subjected to a course of preliminary treatment before operation, and some cases will even escape it. These local measures are beneficial in so far as they succeed in reducing congestion of the parts and improving the circulation.

Prolonged hot vaginal douches at a temperature of 110° F. or higher; glycerin tampons, which on account of the affinity of glycerin for water will abstract it from the tissues and thus reduce capillary tension; and the treatment of infections of the cervix and vulva with iodine and silver nitrate should be employed, and attention given to general hygienic measures. The application of dry heat to the abdomen by means of such apparatus as that used by Gellhorn and according to the method which he advocates is of value.

B. Operative Treatment.—**INDICATIONS.**—Persistent pain is the most prominent symptom that makes operation necessary. The associated adhesions which fix the tube and ovary, frequently enveloping them so that they are completely buried, give rise to a constant tenderness in this region, which is increased on exertion and at the time of menstruation. The bladder is frequently made irritable, and constipation, due to the adhesions involving the rectum and sigmoid, is often a source of distress, while an unpleasant and profuse leukorrhea is a common symptom.

Sterility is not infrequently an important factor from the patient's standpoint, and she will often seek relief with the hope of having children.

Where evidences of tuberculosis or malignancy exist, the indication for operation is positive.

CHOICE OF ROUTE.—The *abdominal route* is the avenue of choice for operative procedures on the appendages. Adhesions can be handled with greater accuracy and safety, and the tissues can be better conserved. It is feasible, of course, during a vaginal operation in which the pelvic cavity is

entered, to operate satisfactorily on the adnexa in many cases, but it should never be the method of choice, as the extent and character of the disease cannot always be accurately determined.

In every case of surgery on the tubes and ovaries on account of salpingitis, a preliminary curettage should be performed, followed by an intra-uterine injection of tincture of iodine. According to Norris, this measure not only destroys any latent gonococci that may be in the endometrium but it prevents, at least temporarily, the infection from extending to the tubes, and thus safeguards the operation.

SALPINGOSTOMY.—The object of this operation is purely to conserve the child-bearing function, but on account of the general unsatisfactory results so far as overcoming sterility is concerned, as well as the not infrequent necessity for a secondary operation to remove the previously conserved tube, it is not an

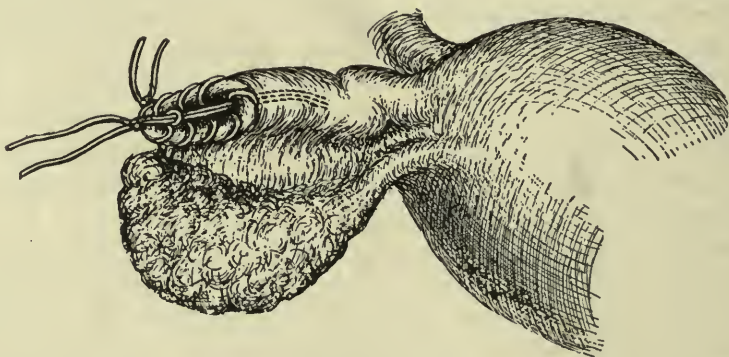


FIG. 1.—SALPINGOSTOMY. Note the rolling out of the mucous membrane of the fallopian tube and the introduction of several strands of catgut in the lumen to insure its remaining open.

advisable procedure except in those cases where the question of maternity is paramount. Martin found but 2 pregnancies after salpingostomy in 65 cases.

The cause of failure is due to the tendency of the gonococcus to persist in the tissues, with resulting closure of the artificial ostium, and as the great majority of all cases of salpingitis are of gonorrheal origin, this is an important factor. As the ostium internum is rarely obliterated and the lumen of the tube is usually permeable, although the external opening is closed, it is possible to resect the external portion of the tube and make an artificial opening, with the hope that it may remain patent.

The diseased distal end of the tube should be amputated obliquely at that point where the tubal wall appears to be normal. Frommel has shown that unless natural conditions are imitated and the tubal mucosa sutured to the peritoneal covering in such a way as to produce an ectropion of the tube, the opening will become converted to a mere slit or will be closed. Interrupted sutures of fine catgut are used to attach the mucosa to the peritoneum, and care should be taken to roll the edges of the mucous membrane well out.

It has been my practice to attempt to insure the patency of this artificially formed ostium by inserting 1 or 2 strands of chromic catgut into the lumen of the tube and to fasten them in situ with an encircling suture to the tubal wall (Fig. 1). The tubal opening should be attached in close proximity to the ovary.

SALPINGECTOMY.—In operations for gonorrheal salpingitis both tubes should be removed unless the possibility of pregnancy is desired. If one tube only is diseased and the apparently healthy one is conserved, it is a common experience that it will have to be removed at a subsequent operation. If we are sure that the cause of the infection was not gonorrhea, the healthy tube may be allowed to remain, with a far greater probability of its remaining normal.

In tuberculous salpingitis, both tubes should be removed, as it is not possible to judge the condition of an apparently normal tube macroscopically. The ovaries and uterus should be conserved unless they show distinct evidence of the disease, as their involvement is rare.

Whenever the tube is to be removed and the ovary of the same side is to be conserved, great care should be observed that the circulation of the ovary shall not be interfered with by the operation, for when the circulation has been disturbed by the careless placing of the ligatures, a previously healthy ovary may become cystic as a result.

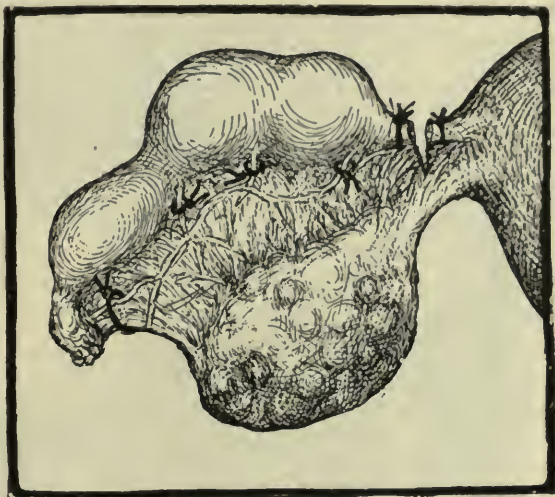


FIG. 2.—SALPINGECTOMY WITH CONSERVATION OF THE OVARY. Catgut ligations are placed around vessels in the mesosalpinx leading to the under surface of the tube, before removing it, so as to avoid interference with the ovarian circulation.

To accomplish this, it is necessary to carefully place fine catgut suture ligatures around all the vessels in the mesosalpinx leading to the under surface of the tube, as well as at the uterine and distal ends. (Fig. 2.)

These vessels are readily seen in the translucent tissues of the mesosalpinx if the tube is lifted upward between the thumb and finger.

The ligatures having been placed, the tube is cut away from the mesosalpinx close to its attachment, until its entrance into the horn of the uterus is reached. A sharp scalpel is then used to excise a wedge-shaped section of the horn of the uterus, so as to include the tubal insertion. A running suture of No. 1 catgut is then used to whip together the edges of this incision, and it is continued along the top of the cut edges of the mesosalpinx.

The round ligament is then caught up about $\frac{1}{2}$ to $\frac{3}{4}$ in. from its uterine attachment and brought over the uterine stump and fastened with sutures to the wall of

the uterus. This effectually covers the line of excision, preventing adhesions and hemorrhage (Fig. 3).

SALPINGO-OÖPHORECTOMY.—The question of removing the ovary with the diseased tube is entirely dependent upon its condition. If its structure does not show signs of disease, as evidenced by cystic degeneration or infection, and only its external surface is covered with plastic exudate or adhesions, it should be saved, especially if the opposite ovary is diseased. If the patient is near the

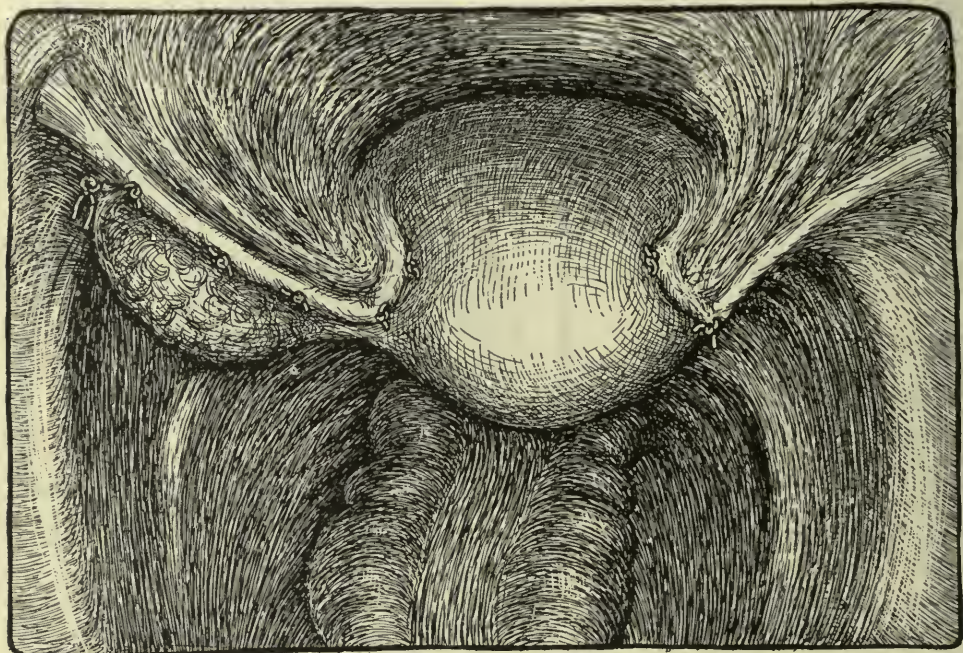


FIG. 3.—SALPINGECTOMY. The left tube together with the right tube and ovary have been removed, and the round ligament used to cover over the uterine stumps.

menopause and pregnancy is not a factor, or if the opposite ovary is normal, it is best not to take any chance of subsequent trouble but to remove it.

When both the tube and ovary are so badly diseased as to exclude the hope of performing any conservative operation on them, and when previous efforts at conservatism have failed, the complete operation should, of course, be done.

Care should be taken to have the intestines thoroughly walled off with gauze, and the abdominal incision likewise protected, so as to avoid their contamination from any purulent contents of the tube or ovary.

The adhesions should next be separated with scissors or fingers under direct vision, until the diseased tube and ovary can be delivered en masse out of the abdominal opening. The mass is then lifted up, and a curved artery forceps is clamped over the infundibulopelvic ligament and along the upper portion of the broad ligament beneath the ovarian attachment to its center. Another forceps is then made to clamp

the other end of the broad ligament, passing close to the horn of the uterus, with its tips overlapping the ends of the opposite forceps.

The tube and ovary are then cut away with scissors just above the clamps. A No. 2 chromic catgut ligature on a curved, round-pointed needle is passed around the infundibulopelvic ligament and firmly ligated. To insure safety, catgut ligatures on vessels should always be tied with a surgeon's knot and then an additional square knot, care being taken not to cut the ends too short. As the ligature is tightened, the assistant should release the forceps and at once catch the stump with them. In case the catgut should break, this procedure will facilitate the securing of the bleeding vessels.

A similar ligature is placed around the uterine end of the broad ligament and back of the forceps in the same manner. An additional ligature may be needed about the center of the broad ligament to secure a vein. The edges of the broad ligament are then closed with a continuous interlocking suture of No. 1 chromic catgut.

Drainage is not necessary except in those cases where we fear a virulent infection and where pus has been spilled. When necessary, it should be made by the vaginal route. (See Chapter IX, *Technic in Operative Gynecology*.)

In cases where both adnexa have to be sacrificed, especially if of gonorrheal origin, a hysterectomy is the operation of choice, as otherwise the diseased uterus will prevent a complete cure. A panhysterectomy is preferable to a supravaginal operation if the cervix shows any evidence of disease.

In cases presenting dense adhesions, which make the finding of a line of cleavage difficult, the method advocated by Barrett is of advantage. The uterine end of the tube is first severed, and it is separated from its broad ligament attachments toward the infundibulopelvic ligament, which is cut last. The remaining mass is then dissected out of the pelvis.

In some instances, the adhesions are very dense and firm, and completely bury the uterus as well as the appendages. Kelly's method is of value here. The fundus having been located, the uterus is bisected down to the internal os, or through the entire cervix if necessary, and each half removed from below upward, with its diseased adnexa. The mass can be enucleated with comparative ease from this direction, when it is nearly impossible to do it from above.

CONSERVATION OF A PORTION OF THE OVARY.—In cases where it is important to conserve some portion of ovarian tissue if possible, on account of the age of the patient or the desire for children, I believe that conservatism should be practiced, even though there is a considerable risk of a subsequent laparotomy being necessary. The possibilities of the operation should be carefully explained to the patient prior to its performance. In these days of aseptic surgery and perfected technic, the danger and annoyance of a possible secondary operation do not weigh against the physical and mental storm of a surgically induced menopause in a young woman, coupled with the knowledge that she can never hope for maternity.

In some cases of ovarian abscess the ovary may be saved by a carefully applied conservatism. Watkins states that he resects small abscesses in the ovaries of young women, preferring to run the risk of a secondary operation rather than an early menopause.

Hyde has reported 5 per cent. of pregnancies in a study of a series of cases of conservative surgery on the ovary, with a like number that returned for a subsequent operation.

DISEASES OF THE OVARIES

I. MALFORMATIONS AND DISPLACEMENTS

A. ABSENCE OF THE OVARY

This is a very rare condition and is usually associated with other defects of the genital tract. It most commonly occurs with an absence of the tube and the corresponding half of the uterus. According to Sutton, there is an absence of the kidney on the same side in a fair proportion of cases.

Congenital absence of both ovaries occurs only when there is a marked defect or a complete failure in the fusion and development of Müller's ducts. The interesting problem presents itself in such a case, of the possibility of transplanting an ovary from another patient. While at the present time such a procedure is not practical, the attempts at the transplantation of ovaries which have been made by Halban, Tuffier, and Martin and the recent experimental work of Carrel and others in keeping tissues and even organs active and functioning for some period of time after removal from the body, give us hope that at some future time, not far distant, such an operation may be perfectly feasible.

B. ACCESSORY OVARIES

Accessory ovaries have been described by various writers, but there is some doubt as to their being developed as distinct and separate organs. Sutton states that "an accessory ovary quite separate from the main gland, so as to form a distinct organ, has yet to be described by a competent observer." There is not much surgical interest in such an anomaly, unless its position causes pain or disease requires its removal.

C. FETAL POSITION OF THE OVARY

The ovary has occasionally been found in its fetal position near the lower pole of the kidney, in close relation to the undescended cecum. Tandler has suggested that, should this malposition be the cause of sterility, the ovary may be brought down to the pelvis and anchored near the fimbriated end of the tube.

D. SACCULATION OF THE OVARY

Reynolds first noted a congenital condition where the ovary is retained in a shallow pocket formed by a fold of the peritoneum of the broad ligament. In the mare and the mouse, and in some varieties of the American monkey, the ovaries are inclosed in a sac of peritoneum in a somewhat similar manner. According to Reynolds, should these ovaries become enlarged, distressing symptoms will be caused by their sacculated position, and he advocates freeing them and closing the pockets by sutures.

E. HERNIA OF THE OVARY

Hernia of the ovary is usually of congenital origin and is frequently associated with other malformations of the genital tract. It may occur at any period of life, but usually in multiparæ, shortly after a confinement. The inguinal type is the most common, but it has been found in femoral, ventral, umbilical, and obturator herniæ, as Andrews and Birnbaum have stated.

The ovary may occupy the hernial sac alone or it may be found with a loop of bowel or portion of mesentery. It is frequently accompanied by the fallopian tube and by the uterus and even by the adnexa of the opposite side. The presence of an ovary should be suspected whenever there is felt within a hernial sac a small, firm, ovoid body which is freely movable and is accompanied by the characteristic ovarian pain on pressure, especially if this body becomes swollen and painful at the menstrual periods. Traction on the cervix may cause sufficient displacement of the body to make the diagnosis positive.

Treatment.—Unless the ovary can be easily returned to the abdominal cavity, a truss is contra-indicated, for obvious reasons. The operative treatment is to do a herniotomy with the replacement of the ovary, if healthy, and its removal if it is diseased.

For a study of the whole subject, the reader is referred to Farrar.

F. PROLAPSE OF THE OVARY

Prolapse of the ovary, in view of its being a not infrequent and an important cause of misery and suffering, deserves more consideration at the hands of authors than it usually receives in the majority of the present-day textbooks on gynecology.

The condition may be divided into 2 classes: (1) when the ovary is prolapsed without an accompanying retrodisplacement of the uterus; and (2) when the ovary accompanies such displacement and is the result of it. Both varieties may be complicated by the presence of adhesions binding the ovary in its abnormal position and rendering postural treatment out of the question.

According to Goldspohn, in 95 per cent. of prolapsed ovaries there is a retroverted uterus. Hanks, quoted by Goldspohn, says that in 33 per cent. of

all uterine displacements prolapsed ovary is present. It is important, however, to realize that there are cases of retroversion with prolapsed ovaries where the ovarian supports are elongated and relaxed and where simply restoring the uterus to its normal position will not overcome the ovarian prolapse. These are the cases of uterine displacement which have not been benefited by operation, the existence of the prolapsed ovaries having been overlooked. Bouney believes that most of the symptoms of retroversion are due to prolapsed ovaries, and makes the point that the ovary drags on the hilum, even though it is lifted up with the displaced uterus, if the ovarian ligaments are elongated.

A. Non-operative Treatment.—Non-operative treatment holds out little chance of success unless the trouble is of short duration and due to subinvolution, or accompanies a recent displacement of the uterus.

B. Operative Treatment.—Formerly, operative treatment consisted of ovariectomy, and many organs that were in no way sufficiently diseased to necessitate their sacrifice were ruthlessly removed. If both ovaries were prolapsed, this was a serious matter, especially if the patient was not approaching the menopause.

To Imlach seems to belong the credit of first suggesting conservation of the displaced organ by fixing the ovary in its normal plane. Sanger and Hirst, independently, devised the method of shortening the infundibulopelvic ligament. Gardner and Bonney shorten the round ligaments. Gilliam suggests attaching the ovarian ligament to the proximal portion of the round ligament, and then shortening the round ligaments after his well-known method, which lifts up the broad ligaments as well. Mauc laire suggested the transposition of the prolapsed ovary to the anterior surface of the broad ligament through an incision or "buttonhole" below the round ligament, passing the fimbriated end of the tube—after cutting the tubo-ovarian fringe to mobilize the ovary—over the top of the infundibulopelvic ligament, and fastening it near the ovary by a suture in order to favor impregnation. This operation was to be accompanied by an hysteropexy if the uterus was retroverted.

Barrows, independently of Mauc laire, advanced this same operation, and devised the transposition of the ovary to the anterior surface of the broad ligament, but placed the ovary *above* the round ligament, between it and the tube. He does not consider it necessary to cut the tubo-ovarian fringe nor to suture the end of the tube in the proximity of the ovary. He shortens the round ligaments by doubling them, and likewise the infundibulopelvic ligaments, which procedure not only holds the uterus well forward, but, in addition, creates a fossa on the front of the broad ligament in which the ovary rests. The technic is well shown in the accompanying illustrations (Figs. 4 and 5).

I have operated according to this method in many cases and I am well pleased with the result of the operation, in addition to its simplicity of execution. Barrows' method of placing the ovary above the round ligament is much to be preferred, as it is easier of accomplishment, and the ovary rests more naturally in that position than if placed under the ligament, and with less danger

of constriction. The Gilliam operation, or one of its modifications, may be employed in conjunction with this procedure. Care should be taken to fasten the round ligament well out toward the internal ring and to make the button-hole somewhat nearer the uterus than ordinarily.



FIG. 4.—PROLAPSE OF THE LEFT OVARY.

The operation is far easier to execute than would appear from the description. If the tube is caught up between the thumb and finger, putting the mesosalpinx on the stretch, the broad ligament at this site appears very thin and translucent, enabling the operator to avoid the branches of the pampiniform plexus of veins running from the tube.

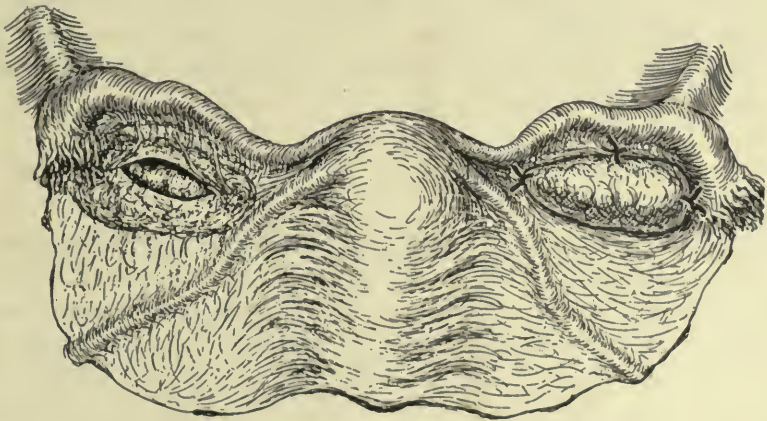


FIG. 5.—MAUCLOIRE-BARROWS OPERATION FOR PROLAPSE OF THE OVARY. On the left a button-hole has been made in the broad ligament preparatory to bringing the ovary through to the anterior surface of the ligament. On the right the ovary has been brought through the buttonhole and secured in position by three sutures to the broad ligament.

The buttonhole is made by passing a pair of closed scissors through the ligaments at a point above the pampiniform plexus and withdrawing them with the blades open. No hemorrhage results from this procedure and the ovary is passed through the slit without any tension on the mesovarium, as that structure and the mesosalpinx are

very lax, especially in cases of prolapse. The buttonhole is made wide enough to prevent any constriction of the pedicle of the ovary. A suture placed at each end of the slit, including the ovary, securely fastens it in position and—except in cases of retroversion or prolapse of the uterus—it is not necessary to shorten the round and infundibulopelvic ligaments.

I have performed the transposition of both ovaries through the anterior vaginal incision, which, so far as I know, is the first time that this operation has been done by the vaginal route. I wish to emphasize its ease of execution by this avenue. The buttonhole is made from before backward and a pair of forceps is slipped through to grasp and draw the ovary forward into place.

The criticism that has been advanced that anteligamentous transposition of the ovary will tend to interfere with fecundation is not well founded. Barrows' and my cases have repeatedly disproved it, and if pregnancy can follow removal of an ovary and tube on opposite sides—as has occurred in cases described by Kelly, Coe, and others—this change in position will have little effect in preventing fecundation.

For a further study of the subject, the reader is referred to Ward on Prolapse of the Ovary and Its Treatment.

II. INFECTIONS

A. ACUTE OÖPHORITIS

An acute inflammatory process of the ovary rarely occurs as an entity except as a complication of mumps or the exanthemata. It usually occurs together with and consecutive to inflammations of the neighboring structures—as the tube, intestines, peritoneum, etc.—as a result of bacterial infection. This condition is considered, together with the acute inflammations on the tube, under Tubo-ovarian Infection (page 306).

B. CHRONIC OÖPHORITIS

Long-standing congestion in the ovary may produce structural changes which are pathological. This "non-suppurative inflammation" may result in the large congested ovary, "oöphoritis serosa," the small contracted type of interstitial oöphoritis, or in the small cystic degeneration resulting in follicular cysts of the ovary or in cyst of the corpus. These retention cysts of the ovary, although they may cause the complete destruction of the ovarian stroma, leaving only a shell containing fluid, are not, properly speaking, new growths and should not be classed as such. Although these pathological conditions produce gross changes in the ovary, they do not necessarily imply that the organ must be removed.

All the factors in each case must be carefully considered before such an important organ as the ovary should be condemned. The age of the patient, the desire for children, the mental state, the condition of the nervous system,

previous operations, social status, and the condition of the other ovary are all to be taken into account, as well as the extent and character of the disease and the degree of suffering, before arriving at a decision as to whether the ovary is to be removed, treated by conservative surgery, or is to be let alone.

A. Non-operative Treatment.—The non-operative treatment is simply to employ such well-known measures to relieve the chronic congestion that is present, as the knee-chest posture, depletion with glycerin tampons, prolonged and very hot douches to contract the capillaries, and counterirritation with iodine.

B. Operative Treatment.—The operative treatment consists in removing the ovary, if sufficiently diseased, or, if it is considered best to conserve the

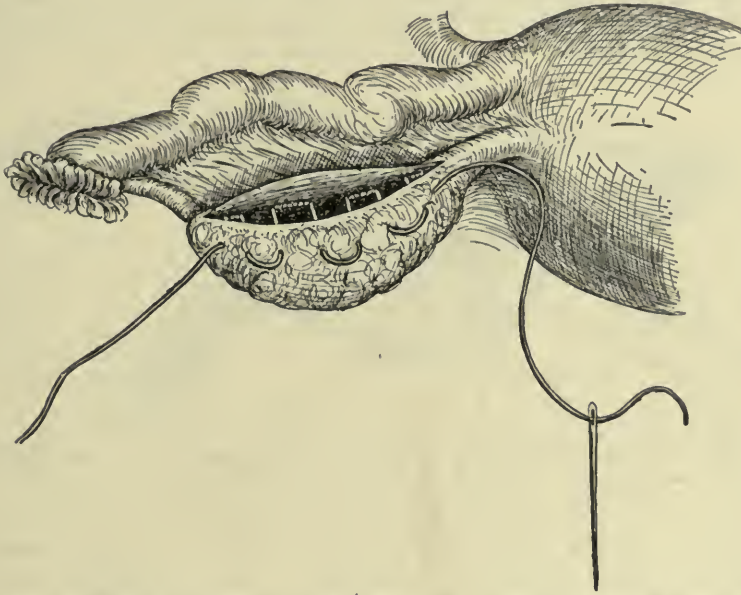


FIG. 6.—AUTHOR'S METHOD OF RESECTING THE OVARY. A Continuous Mattress Suture is placed at the base of the excision to control hemorrhage.

organ, the removal of the diseased area or cyst only, with the retention of the healthy portion, as determined by the gross appearance.

The removal of one or both ovaries may be necessitated (1) when there is an alteration of the ovarian secretion, or (2) for the effect of this internal secretion, whether altered or not, on other organs or structures. Instances illustrative of this are in the removal of the ovaries for osteomalacia or in very large fibroid growths of the uterus, where a more radical operation is contra-indicated, and in Bateson's operation for their removal in cases of inoperable carcinoma of the breast.

OÖPHORECTOMY.—To remove the ovary without the tube, the ovary is grasped with a forceps and lifted up so as to make prominent its attachments

to the broad ligament and uterus. A ligature on a round-pointed needle is passed through the mesovarium at its center and then through the ovarian ligaments and ligated. A similar ligature is placed around the outer portion and the ovary is cut away from its attachments. A continuous catgut suture is then placed so as to cover over the small stumps with the peritoneum of the broad ligament.

RESECTION OF THE OVARY.—In resecting a diseased portion of an ovary I have found the following technic to be simple and rapid of execution and at the same time it insures perfect hemostasis and a proper approximation of the cut surfaces.

The ovary is seized with Allis' clamps at the ovarian ligament and at its outer border, and is steadied by the assistant. The area to be removed is grasped with a broad mouse-tooth thumb forceps, and with a sharp scalpel the diseased tissue is resected with an elliptical incision carried well down in a wedge shape into the sound

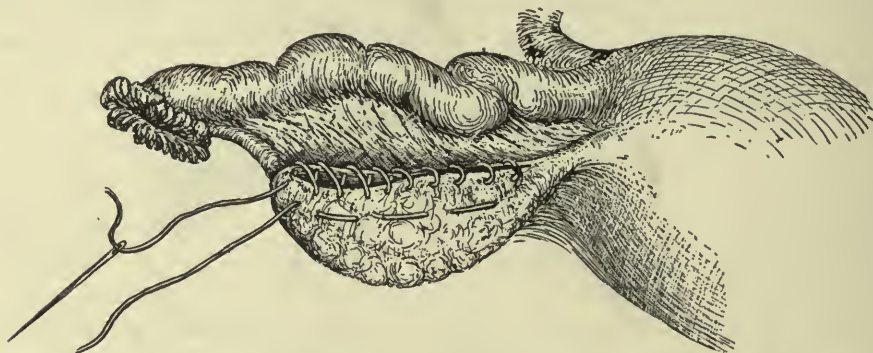


FIG. 7.—AUTHOR'S METHOD OF RESECTING THE OVARY. The same suture is then used to coapt the edges of the wound by a top stitch back to the starting point of the mattress suture.

ovarian structure. A No. 1 plain catgut suture threaded on a straight needle (a fine Keith needle is best), commencing at one end of the resection, is passed straight through the ovary near the bottom of the incision from side to side as a continuous mattress suture (Fig. 6). When the other end of the resection has been reached, the same suture is carried back along the edges of the incision with an over-and-over stitch to the starting point, where it is tied to its other end. The mattress portion of the suture secures an approximation of the deep portions of the resection and this insures against the formation of a hematoma (Fig. 7).

C. VARICOCELE OF THE OVARY

The pampiniform plexus of veins situated in the broad ligament near the attachment of the ovary is very prone to enlargement and dilatation due to back pressure, precisely as it occurs in the same plexus adjacent to the testicle. Owing to the very frequent condition of venous stasis in the ovarian veins, the result of their anatomical peculiarities, the formation of a varicocele occurs, and the symptoms of aching and dragging are similar in both the male and the

female. It is a not infrequent experience for operators who have made a diagnosis of salpingitis, oöphoritis, or salpingo-oöphoritis, to find on opening the abdomen that both the tube and ovary are normal and that a condition of varicocele of the pampiniform plexus is present.

If the veins are very large, they may be ligated according to the method of Reed, with fine silk ligatures. I have had very satisfactory results in relieving this condition by employing the Maclaure-Barrows operation for prolapse of the ovary, described on page 317. By this simple operation, the ovary is lifted up and transposed through a buttonhole in the mesosalpinx to the anterior side of the broad ligament, and the effect of lifting up and supporting the ovary is the same as when a suspensory bandage is employed in the male. In the moderate degrees of varicocele, this procedure will suffice, and in my opinion it should always be done in addition to the operation of ligating the veins, should that be considered necessary.

III. NEOPLASMS OF THE OVARY

Classification.—Neoplasms of the ovary may be classified according to their origin, as follows:

EPITHELIAL GROWTHS:

- Cystadenoma.
- Papilloma.
- Adenocarcinoma.
- Chorio-epithelioma.

CONNECTIVE-TISSUE GROWTHS:

- Fibroma.
- Myoma.
- Sarcoma.

MIXED TYPE:

- Krukenberg.

FETAL INCLUSION:

- Embryomata.
- Dermoid.
- Teratoma.

PAROVARIIUM:

- Parovarian.
- Hydatid of Morgagni.
- Gärtnerian cyst.

They may be classified as to their character as:

BENIGN:

- Multilocular cystadenoma.
- Dermoid.

BENIGN:—*Continued.*

Fibromyoma.

Parovarian cyst.

Gärtnerian cyst.

SEMIMALIGNANT:

Papilloma.

MALIGNANT:

Carcinoma.

Sarcoma.

Chorio-epithelioma.

Krukenberg.

Teratoma.

Indications.—The presence of a well-defined ovarian tumor demands surgical interference. The subjective symptoms of pain and local disturbance or the state of the general health may be of little value in estimating the seriousness of the growth. The clinical findings are of even less value. A large tumor filling the pelvis and abdomen may prove to be a benign cyst, while a small growth in one ovary may be a malignant adenocarcinoma. The statement made by Kelly that "all ovarian tumors must be considered as malignant until removed and proved otherwise," is sound advice, for it is well known that the most benign cyst may undergo malignant changes.

Delay in removing even benign growths may lead to the development of serious complications in the tumor, which greatly increase the danger of the operation and lessen the chance of ultimate success, as infection and gangrene, which may be the result of strangulation.

The indications for immediate removal are:

1. If there is evidence of a definite neoplasm rapidly increasing in size or injuring the patient's health.

2. If a growth of the ovary is developed at the time of the menopause, or if there is an increase in size of an old chronic condition, especially if it is associated with a family history of carcinoma. Cancer of the ovary is frequently secondary to cancer of the breast or stomach, by metastasis.

3. In a rapidly growing ovarian tumor accompanied by ascites, especially if the patient is a young adult or has not reached the age of puberty. Such a growth would probably be a sarcoma, although this is one of the rarest of ovarian tumors.

4. When a tumor, which is irregular in contour and of unequal consistency, occurs in childhood or early adult life a dermoid or teratoma should be suspected.

5. In cases which develop symptoms of torsion of the pedicle, hemorrhage into the cyst, rupture of the cyst wall, pressure on the ureters, intestinal obstruction, or when even a tumor is likely to cause an obstruction to labor.

TREATMENT OF NEOPLASMS OF THE OVARY

A. Non-operative procedures have no place in the treatment of ovarian growths.

According to Halban, Röntgen rays may sterilize normal ovaries but they cannot check the formation of ovarian tumors. The treatment is essentially operative and the growth may be removed by the vaginal as well as by the abdominal route, in suitable cases.

B. Operative Treatment.—**A. VAGINAL ROUTE.**—The removal of ovarian tumors by way of the vagina is limited to non-adherent cystomata not larger than an adult head and to growths that are situated deep down in the pelvis so that if adherent they may be reasonably accessible. It must be borne in mind that this route is a dangerous one, especially if adhesions are present, as their blind separation by sense of touch alone makes it impossible to avoid injury to the intestines, bladder, and blood-vessels in certain instances. These dangers far outweigh the advantages of a smoother convalescence.

Schuchardt's paravaginal incisions should be employed in cases where there is insufficient room in the vagina to allow proper access to the pelvis. Either an anterior or posterior colpotomy may be employed to enter the pelvis. An anterior colpotomy made with an inverted T incision, with a wide dissection of the vaginal flaps and a free separation of the bladder from its vaginal and uterine attachments, gives the largest entrance for the removal of ovarian growths; but a posterior colpotomy is simpler and more suited to reach small growths situated in the culdesac. If the cyst is too large for easy removal through this incision, it should be punctured and when its contents have been evacuated the collapsed sac can readily be delivered. The pedicle should be clamped and the tumor cut away. If the vessels in the pedicle are large, they should be individually ligated and then covered over by suturing the peritoneal edges together with a continuous catgut suture. If the pedicle is small, it should be ligated with a suture ligature which penetrates each side of the stump.

Solid growths may be removed by morcellement, if necessary.

B. ABDOMINAL ROUTE.—Formerly, tapping large ovarian cysts was considered a justifiable procedure as a means of giving temporary relief, on account of the danger of an abdominal section. Tapping would today be justifiable only in rare cases of a very large tumor causing marked dyspnea, where it would be an advantage to reduce the pressure a few days prior to the operation, in order to allow the respiratory apparatus and the circulation to readjust themselves.

The median incision is preferable in large growths, as it can be readily extended should the occasion arise.

It should be the endeavor of the operator to remove intact, and without rupture, growths of such size as may be delivered through the incision. If this is not possible,

the cyst should be evacuated of its contents with a trocar, without soiling the abdominal cavity, and the collapsed sac withdrawn through the incision after the freeing of any adhesions that may be present. Bands of tissue and all omental adhesions should be carefully ligated before cutting. The pedicle is then clamped and the tumor cut away. The vessels in the stump of the pedicle should be picked up with artery forceps and individually ligated with catgut (Fig. 8). The raw surface of the stump is then covered over by suturing the peritoneal edges together with a continuous right-

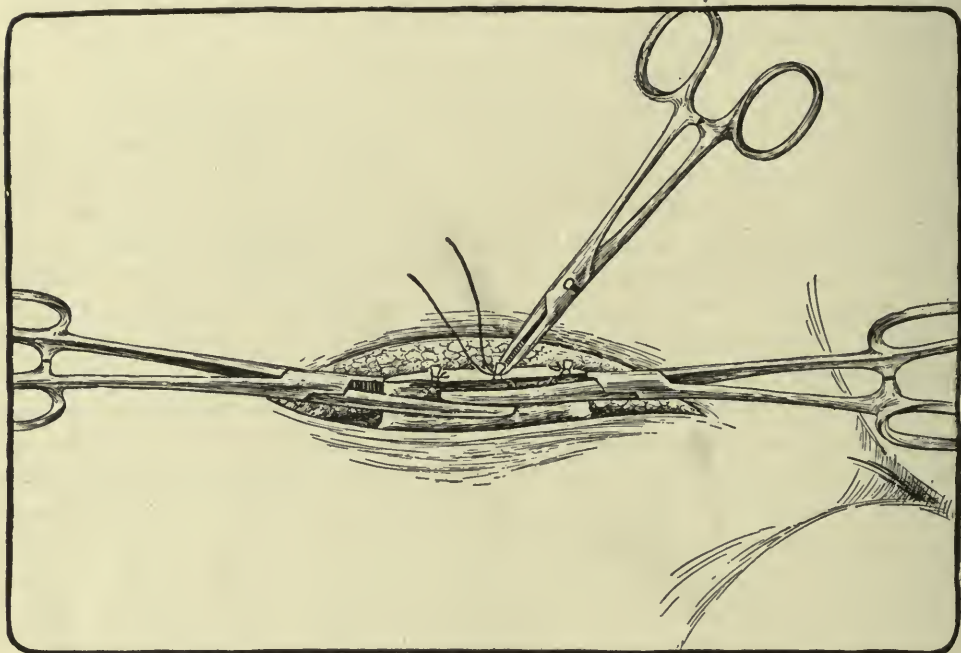


FIG. 8.—SEPARATE LIGATION OF THE VESSELS IN THE PEDICLE OF AN OVARIAN CYST.

angled Cushing suture of catgut, placed on its border so that the cut edges will be turned in on drawing the suture tight. The vessels are thus doubly protected, and no raw surface is left to become adherent to adjacent tissues (Fig. 9).

Care should be taken to examine the condition of the other ovary, as the disease is frequently bilateral.

In all cases of malignancy a careful palpation of the liver and stomach should be made for evidences of metastases or of a primary growth, as the ovarian carcinoma is frequently secondary.

Malignant papillary cysts have thin walls which are easily ruptured and thus allow the dissemination of papillomatous tissue in the abdomen.

The contents of dermoid cysts seem to be liable to cause severe infection if brought in contact with the peritoneum; therefore, every effort should be made to avoid rupturing them.

Intraligamentous cysts must be removed by splitting the peritoneum of the broad ligament and by carefully shelling out the growth from its bed, after

ligating both its uterine and pelvic attachments. The cavity should be closed by suturing the opening in the broad ligament. In certain cases it may be necessary to pack the cavity with gauze, should there be a tendency to oozing, in order to prevent a hematoma. One end of the gauze should be carried through an opening made into the vagina, so that it may be partially removed each day.



FIG. 9.—THE PERITONEAL EDGES OF THE PEDICLE SUTURED TOGETHER COVERING THE BLOOD-VESSELS AND RAW SURFACE.

The danger of injuring the ureter must be borne in mind in removing an intra-ligamentous growth, as it may lie in the wall of the tumor.

In difficult, deep-seated cases, the method of Fleming is of advantage. This consists in a supravaginal hysterectomy, commencing on the normal side and, after cutting across the cervix and ligating the uterine artery on the diseased side, an enucleation of the cyst from below upward with the uterus.

ECTOPIC PREGNANCY

Whenever the impregnated ovum is arrested in the course of its progress to the uterine cavity and goes on to development in such an abnormal position, it is a pregnancy out of place or an "ectopic gestation." Until 1883, this condition was regarded as rare, but since that date, when Lawson Tait first operated for a ruptured tubal pregnancy, we have learned that it is a frequent condition, occurring in from 4 to 5 per cent. of abdominal gynecological operations.

Classification.—From a practical point of view, we may regard all cases of ectopic pregnancy as of tubal origin, as those cases of ovarian pregnancy where the ovum goes on to development within the graafian follicles are so extremely

rare—only 35 authentic cases, according to Williams, have been reported—that they need not be considered in the classification. Tubal pregnancies are classified, according to the site of the development of the ovum in the tube, into ampullar, isthmic, and interstitial pregnancy.

A. The ampullar variety, in which the ovum develops in the outer third of the tube, is the most frequent form. It is in this type that the ovum may be extruded into the abdominal cavity through the fimbriated opening of the tube.

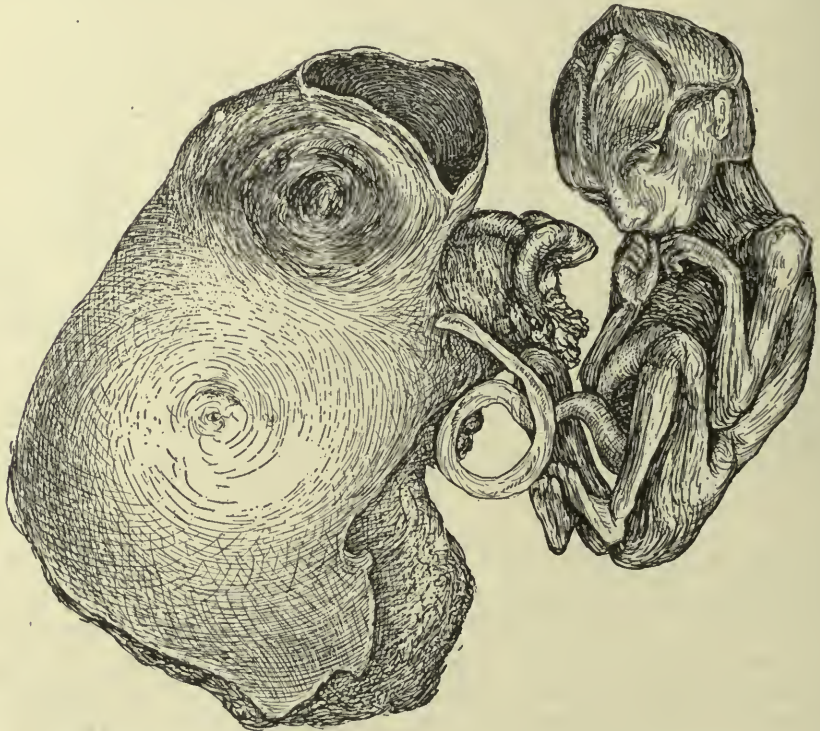


FIG. 10.—RUPTURED INTERSTITIAL PREGNANCY AT $4\frac{1}{2}$ MONTHS. Hysterectomy. Recovery.
(Case in the practice of the writer.)

B. In the isthmic pregnancy, the ovum is arrested in any portion of the tube between the ampulla and the horn of the uterus.

C. Interstitial pregnancy is the rarest form of tubal gestation, and was first accurately described by Carus, only as late as 1822. The first case to be reported is usually attributed to Mauriceau, in 1669, but later investigations have proven this to be a case of pregnancy in a rudimentary horn of a uterus unicornis, and the first authentic case was that noted in 1718, by Dionis, who described the ovum lying in that portion of the tube which passes through the wall of the uterus. There are probably less than 100 authentic cases reported in the literature (Fig. 10).

Combined Pregnancy.—Pregnancy may occur in both the uterus and tube at

the same time. Weibel, in 1905, collected 119 cases from the literature, and several have been reported since.

Multiple Tubal Pregnancy.—One tube may be the seat of a twin pregnancy when it contains 2 embryos of the same age, or a simultaneous pregnancy occurs when each tube contains an embryo of the same age (Figs. 11, 12).

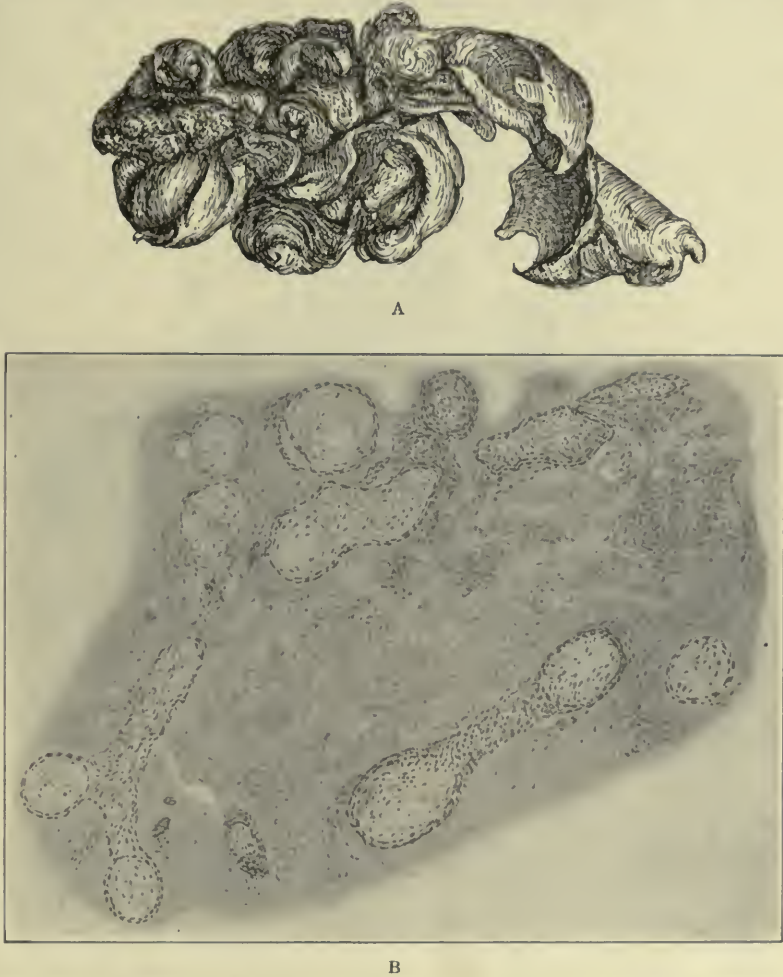


FIG. 11.—BILATERAL ECTOPIC PREGNANCY. Operation. Recovery. A, The right tube was ruptured and showed chorionic villi. B, chorionic villi from the ruptured right tube.

Findley has collected 28 cases in the literature up to 1910, but of these, only 8 were undoubted. Milligan, in 1912, reported a similar pregnancy and I, also, have reported a case. Snger and Krusen have reported a case of triplet tubal pregnancy, where all 3 of the embryos were found in the fallopian tubes and all were of the same age.

Repeated Ectopic Pregnancy.—According to Smith, who has made a study of the subject, repeated ectopic gestation has occurred 113 times out of 2,998

cases. Coe reports a case of tubal pregnancy, of unusual interest, where the tube at operation was found to contain a second ovum from a tubal pregnancy 11 years previously.

Course and Termination.—Ectopic pregnancy may terminate in either tubal abortion, death of the fetus before rupture of the tube, rupture of the tube into the abdominal cavity, or between the layers of the broad ligament, or into the uterine cavity.

Rupture of the tube occurs, during the early months of gestation, either into



FIG. 12.—BILATERAL ECTOPIC PREGNANCY. Same case as in Figure 11. The left tube was unruptured and contained an embryo. (Case in the practice of the writer.)

the peritoneal cavity or between the folds of the broad ligament. The fetus may not die at once, but may go on in its development to full term, when a spurious labor occurs with death of the child. Rupture into the cavity of the uterus occurs only in cases of interstitial pregnancy.

A. TUBAL ABORTION.—Whenever the ovum is partially or completely expelled into the abdominal cavity through the fimbriated end of the tube, it is classed as a tubal abortion. This accident always occurs before the end of the eighth week after conception, as the abdominal ostium of the tube is entirely closed by that time. In these cases, the conception is developed in the ampulla of the tube. The expulsion is usually accompanied with hemorrhage, pain, and shock, but where the ovum is not completely expelled it may block the ostium of the tube sufficiently to check the hemorrhage, and the patient may recover without operation. An hematosalpinx may result, with or without subsequent infection. Tubal abortions are more frequent than ruptures of the tube, oc-

curring in about 75 per cent. of all ectopic pregnancies, and nearly all cases of pelvic hematocele are of that origin.

B. DEATH OF THE FETUS BEFORE RUPTURE.—Occasionally it may happen that the fetus dies very early in the pregnancy, before rupture. In such a case, the gestation sac with its contents is converted into organized tissue, known as a tubal mole. If this does not become infected, it may be retained indefinitely without causing any particular symptoms.

C. RUPTURE OF THE TUBE.—Rupture of the tube is a direct result of overdistention or of erosion of its walls, due to the rapidly growing fetus. Any form of external trauma may hasten this termination.

RUPTURE INTO THE ABDOMINAL CAVITY.—When the pregnancy is of the ampullar or isthmic variety, it almost invariably ruptures before the fourteenth week. The usual time is between the fourth and twelfth week, and the majority of cases rupture about the eighth week.

In interstitial pregnancy, rupture occurs much later, usually at the end of the fourth month. The limits of time are the fourth and the twentieth weeks.

The rupture usually occurs suddenly and is accompanied with violent pain, severe hemorrhage, and collapse. Sometimes the rent in the tube may occur gradually, in which case the development of hemorrhage and shock is much slower. The interstitial variety is the most dangerous, as death may occur promptly owing to the greater severity of the hemorrhage.

RUPTURE BETWEEN THE LAYERS OF THE BROAD LIGAMENT.—This termination may occur if the tube gives way on its inferior border in the middle portion. In this location the layers of the broad ligament are widely separated, and the ovum and its membranes fill this cavity. The hemorrhage, of course, is limited and if the attachment of the placenta is undisturbed the fetus may live and develop to full term. If the fetus dies, the resulting mass may become absorbed, or may become infected, with resulting abscess formation, and the fetal parts may be discharged through sinuses; or a deposit of lime salts may convert the fetus into a lithopedion; or it may undergo adipoceration. A secondary rupture of the broad ligament sac may occur.

RUPTURE INTO THE UTERUS.—Rupture into the uterine cavity may occur in the interstitial variety of tubal pregnancy. This is the most favorable termination, as the fetus, if it dies, is expelled later as an abortion. Should the placental site remain undisturbed, it is possible for the fetus to develop to term and be delivered in the natural way. In nearly all cases where the fetus goes to full term, it is poorly developed, puny, and frequently deformed.

TREATMENT OF ECTOPIC PREGNANCY

In the light of our present knowledge of ectopic pregnancy, no place can be accorded to palliative treatment. Especially is this true when we consider the brilliant results of prompt surgical intervention.

Non-surgical measures are obsolete and are only to be employed in the interval between the making of the diagnosis and the operation, while the necessary preparations are being made. They consist of the ordinary measures to combat shock and internal hemorrhage. The placing of a sand-bag over the lower abdomen is of value, and also the administration of a saline solution per rectum or in the breast.

Treatment before Rupture (Fig. 13).—Should the patient be fortunate enough to have her dangerous condition recognized before rupture, no delay whatever should be countenanced, and the operation for the removal of the impregnated tube should be done as soon as proper preparations are completed. Under these conditions, the operation is a safe one. The abdominal route should always be preferred. The technic is simple and consists in the removal of the enlarged tube, according to the usual method for salpingectomy (see page 311). The ovary should be conserved unless it is so involved by adhesions with the enlarged tube as to render it difficult to save, or unless it is diseased.



FIG. 13.—EARLY (5 WEEKS). UNRUPTURED TUBAL PREGNANCY. Operation. Recovery. The uterus was removed in this case as an interstitial fibroid was noted at the fundus, and the patient had an incipient pulmonary tuberculosis, a tuberculous ulcer of the intestine, necessitating a resection of the intestine, and the husband gave a history of lues. (Case in the practice of the writer.)

An interesting question arises as to the disposition of the opposite tube at the time of operation. An exhaustive study of this question has been made by Richard Smith. He states that the strong tendency of the last decade to-

ward conservation of the pelvic organs has resulted in the saving of the opposite tube by most surgeons, unless it is diseased, and it is his opinion, as a result of his study, that we must modify this practice. We are unable to judge of the condition of a tube by its macroscopical appearance and we should be guided rather by the woman's condition relative to age, previous child-bearing, her health, her wishes, and the knowledge of the danger lurking in the tube that is left, whatever its appearance.

Smith concludes: 1. If a woman has had no children and is desirous of having them, we should conserve the opposite side unless it is hopelessly closed. We do this deliberately with the full knowledge that further pregnancies may not occur and that she may have, in spite of the normal appearance of the tube, a future ectopic gestation.

2. In women who have borne children, we may be governed by the desire to have more, and may leave the tube unless it is absolutely closed.

3. In women who have had children and have borne as many as they de-

sire, we should unhesitatingly remove the opposite tube and preclude the possibility of further accident, whether the tube appears normal or not.

Treatment at the Time of Rupture.—Until 1907, the general practice among surgeons was to do an immediate operation in all cases seen at or shortly after the time of rupture, on the assumption that the patient would rapidly succumb to the hemorrhage if it was not promptly checked. Consequently, the patient was operated upon while in a state of profound shock and had to stand the added shock of operation. Undoubtedly this additional operative shock has been the last straw that has contributed to a fatal result in many instances. Hunter Robb, in 1907, Simpson and Stillwagen were the first to sound a note of caution as to the accepted practice of no delay in such cases.

A complete review of the statistics in Germany, made by Hartog, showed that no more than 5 per cent. of all ectopic pregnancies die from hemorrhage at the time of rupture; while the operative mortality in 1,176 cases, in 25 clinics, was 8 per cent. Robb calls attention to the fact of how rarely we see an actual bleeding vessel at the time of operation. In almost every instance, by the time the abdomen can be opened the active bleeding has ceased, and that which may be encountered is the result of the operator's manipulations in removing clots, etc.

Robb's extensive experiments made on dogs, where the ovarian and uterine arteries were severed, show that we are justified in believing that intra-abdominal hemorrhage, such as is met with in women in collapse from a ruptured ectopic pregnancy, is not sufficient in itself to cause a fatal termination. Therefore, the surgeon should weigh very carefully the question as to whether or not it is wise to operate immediately in such cases. A hasty operation performed under disadvantages which militate against proper asepsis is an added risk which it is not justifiable to take in view of our present knowledge. While preparations for operation should be instituted at once, no detail of aseptic technic should be omitted and ample assistance should be secured, while in the meantime measures to combat the shock and to stimulate the patient should be carried out.

In cases where the patient is not greatly shocked, as when the symptoms point to a moderate degree of hemorrhage, as often occurs in tubal abortion, the operation should be proceeded with as soon as all the preparations for a proper technic are completed. In cases where the loss of blood has been sudden and excessive, so that the patient shows the signs of severe shock and collapse, the operation should be deferred, although all the preparations should be proceeded with. The patient should be given hot saline enemata, administered slowly; also saline infusions under the breasts should be employed. The foot of the bed should be elevated, and a sand-bag placed over the lower abdomen. Robb's experiments show that weights on the abdomen are of positive value in limiting hemorrhage. A hypodermic of morphia, gr. $\frac{1}{4}$, and atropia, gr. $\frac{1}{150}$, should be given. External heat is applied to the body. Strychnia, gr. $\frac{1}{30}$, hypodermically, may be given, as indicated.

The patient is carefully watched for signs of improvement, which nearly always takes place, and when the signs of shock have disappeared—which usually occurs within 24 to 48 hours—she should be moved to the hospital, if possible, and the operation performed, as McMurtry has aptly stated, “during the ascending wave of reaction instead of during the descending current of increasing collapse.”

TECHNIC OF OPERATION.—Care should be taken not to unnecessarily manipulate the abdomen during its preparation. An intravenous saline infusion should be started as soon as the patient is anesthetized, and continued during the operation until 1,000 or 1,500 c. c. have been given.

The patient should be placed in the Trendelenburg position and on opening the abdomen the ruptured tube should be sought for and brought into view. A clamp is placed on the infundibulopelvic ligament, thus controlling the ovarian vessels, and another is applied to the uterine end of the tube. These clamps thus effectually control all hemorrhage, and the salpingectomy is proceeded with as previously described.

The clots should be rapidly but gently removed with the hand or sponges, and a hot saline solution poured into the abdomen and allowed to remain. The abdomen is then closed without drainage. If the patient's condition remains precarious, a transfusion of blood should be done, if possible.

Treatment of Late Cases of Rupture.—Certain cases are not uncommon where the patient is not seen until some days or weeks have passed, and she has recovered from the effects of the primary rupture. She is then left with a large hemocele, which should be removed, as there is considerable danger of infection owing to the proximity of the intestines and secondary hemorrhage may occur.

Treatment in the Advanced Months of Gestation.—Before the end of the fourth month the entire sac can usually be removed without fatal hemorrhage from the placental site. The sac being situated usually between the layers of the broad ligament as a result of the rupture being on the inferior border of the tube, the operation is necessarily somewhat difficult. The ovarian and uterine arteries are clamped and ligated, and the gestation sac enucleated as if it were an intraligamentous cyst. The cavity is then closed with buried catgut sutures.

After the fourth month, the great danger of the operation is the inability to remove the placenta without uncontrollable hemorrhage if the child is living. Many authorities therefore advise awaiting the death of the child, as then the placental circulation has been obliterated through the formation of thrombi, and at the end of 2 weeks the placenta is more likely to be removed with safety. Others deem that the danger of waiting outweighs this doubtful advantage, as fatal hemorrhage has occurred during operations done several weeks after the death of the fetus. The consensus of opinion is that it is wisest not to delay but to operate as soon as the condition is recognized, although Peterson advocates delay until 2 or 3 weeks before term.

TECHNIC OF OPERATION.—After opening the abdomen, the sac is care-

fully incised at a site distant from the placenta, and the child is removed. The cord is ligated close to the placenta, and the sac is marsupialized by suturing its margins to the lower edges of the abdominal incision. The sac is then packed with gauze. After 48 hours, a part of this gauze is removed each day. The placental circulation gradually becomes thrombosed, the placenta begins to be detached and come away in pieces at the end of 1 or 2 weeks, and the sac closes. This is a very unpleasant process on account of the putrefaction which takes place in the placenta and the resulting septic absorption. Ayres has suggested the plan of injecting the placenta while in situ, through the vessels of the cord, with a solution of $1\frac{1}{2}$ per cent. of formalin, with the object of preventing this decomposition.

Treatment of Interstitial Pregnancy.—If the rupture should fortunately be into the uterine cavity, the condition is treated as an abortion. In cases of intraperitoneal rupture, it is usually necessary to do a supravaginal hysterectomy, as the fundus of the uterus is so torn by the rupture that it is not wise to attempt to conserve it. In the earlier cases, however, it may be feasible to excise the sac and suture the opening in the uterine cornu. According to Bland Sutton, this cannot be safely done if the pregnancy has advanced beyond 2 months.

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CHAPTER XII

FIBROMA OF THE UTERUS

HOWARD C. TAYLOR

Instruments.—No special instruments are required for any of the operations for removing fibromata of the uterus. The ordinary instruments needed for any abdominal operation are sufficient. The following is a list of the instruments used by me in my own work: knife; seissors, straight and curved on the flat; artery clamps; pedicle clamps; retractors; volsellum forceps; bullet forceps; needles; needle-holder.

The knife and seissors are the ordinary instruments. The artery clamps are straight with each jaw entirely serrated so that they can be used as small pedicle clamps. The pedicle clamps are about 20 cm. long, so that they will reach to the bottom of the pelvis; each jaw is completely serrated, with mouse teeth at the end. They should not be large or heavy as it is never necessary to use great force and they are less clumsy and in the way if they are light. There should be 3 sets of retractors. Two sizes are for retraction of the abdominal walls of different degrees of thickness. The third size should have a long, flat blade that will reach to the bottom of the pelvis, as deep exposure is often necessary to control all bleeding. These same retractors can be used for both abdominal and vaginal operations. A large volsellum forceps with 2 or more heavy teeth in each jaw is used for grasping the tumor, raising it from the abdominal cavity, and moving it about. The tumor is too smooth to hold easily without some instrument. Some operators use an instrument fashioned like a large corkscrew, but I prefer the volsellum forceps. For small tumors, for holding the cervix, and for the more delicate work, a single volsellum or bullet forceps is needed. This instrument should be light, with a single fine tooth in each half.

I rarely or never use an aneurysm needle for passing ligatures but use a needle and needle-holder instead. It is easier and quicker for me to pass a needle and draw it through with the ligature than to have an assistant catch the ligature passed with an aneurysm needle.

The needle should have a smooth round point without a cutting edge, it should be flattened toward the eye so that it can be held firmly in the needle

holder without turning, and its eye should be large enough to be quickly threaded with the suture material of the required size. The needle-holder should be of such length that it will easily reach to the bottom of the pelvis without the operator's hand obscuring the field of operation; it should hold the needle firmly but, what is equally important, it should be one that will easily let go of the needle and catch it again. The one used by me is a straight instrument with smooth jaws, to the surface of one of which is fastened a piece of copper. All suture material used in the abdomen by me for the operations for the removal of fibromata of the uterus is **plain catgut**.

INDICATIONS FOR OPERATION

The presence of a fibroid tumor in the uterus is not a sufficient indication for an operation for its removal. If the growth is small and gives no symptoms, ordinarily there is no indication for an operation. The usual rule that applies to a tumor of the breast, that any tumor should be removed as soon as it is discovered, does not apply here, because the removal of a tumor from the breast is associated with practically no mortality, while the removal of any tumor from the uterus is associated with a greater risk. Furthermore, the tumor that is diagnosed as a fibroma of the uterus is rarely confused with a tumor which is of a malignant nature. It is safe, therefore, and the better plan, not to operate for a fibroma of the uterus until such time as it gives symptoms, until it reaches some size, or until it shows signs of a malignant or degenerative change. The indications for operation are: pressure on the surrounding organs, pain, increase in size, and change in the amount, duration, or frequency of the menstruation. The pressure on the surrounding organs usually means pressure on the bladder with the increase in frequency of urination that would naturally accompany it. Pressure on the bowel causing real obstruction of the bowel is comparatively rare even though the fibroid tumor is of a size and shape to fit accurately in the pelvis. Pain with a fibroma of the uterus is more frequently present when the tumor is of relatively small size and is supported with the uterus by the ligaments of the uterus. When the fibroid tumor is larger and supported on the brim of the pelvis, the pain is usually a less important factor. A tumor which is attached to a small pedicle so that it is movable is frequently a cause of pain on account of the irritation of the peritoneum due to the mobility of the tumor. The disturbance of menstruation may be in any one of 3 ways. Menstruation may be increased in amount, it may be increased in frequency, or it may be increased in the duration of the flow. A **curettage** alone for the disturbance of the menstrual period in the presence of a fibroma uteri is rarely indicated, as in these cases the fibroma is the cause of the menstrual change and unless the fibroid is removed the cause remains and there will be a recurrence of the menstrual disturbance.

Pressure on Surrounding Organs.—**INTESTINES.**—Pressure of a fibroma of

the uterus on the intestines sufficient to cause an intestinal obstruction is not common, though it is not infrequently a factor in **the production of chronic constipation**. Even in the cases where a fibroid fits so accurately in the pelvis that, though not held by adhesions, it can be raised out of the pelvis only with difficulty, there is usually no real obstruction. In cases where there is an intestinal obstruction associated with fibromata uteri, the obstruction is more frequently caused by adhesions between the tumor and the intestines, with kinking of the gut, than by pressure of the tumor on the rectum. When the tumor has reached such a size that it has grown out of the pelvis and rests on its brim, the pressure exerted on the rectum is less than when the tumor is smaller and entirely confined to the pelvis. Pressure on the rectum is more frequently an indication for an operation for a fibroma uteri to relieve constipation than for an intestinal obstruction, and the tumor is usually one of moderate size, still limited to the pelvis. The presence of the tumor not infrequently interferes with the return blood supply of the rectum, and this, with the constipation, causes **hemorrhoids**.

URETERS.—A fibroma uteri does not often cause trouble by pressure on the ureters, but at times one or both ureters are caught between the brim of the pelvis and the tumor and a **hydro-ureter** is produced. Such a condition can be relieved only by the removal of the growth.

THE BLADDER.—The position of the bladder may be disturbed in 2 ways by a fibroma of the uterus. If a fibroma originates in that part of the wall of the uterus to which the bladder is attached, or if it becomes adherent to a fibroid higher up, as the tumor and uterus increase in size, the bladder is drawn upward with them. In some cases the bladder, though empty, is nearly as high as the umbilicus. This fact should be remembered when opening the abdomen in the presence of a large fibroid; otherwise the bladder will be injured. A fibroma of the uterus starting in the anterior wall may grow downward, pressing on the bladder and interfering with its distention. It is my experience that **the fibroma pressing on the bladder** frequently causes an irritability of that viscus which indicates the removal of the tumor, and that **the bladder that is drawn up into the abdomen rarely gives symptoms**.

Retention of urine, when caused by a fibroma uteri, is due to a sudden change in the position of the tumor or to a sudden increase in its size, produced by an interference with its blood supply, by infection, degeneration, or menstruation.

Pain.—Pain as an indication for operation is observed more frequently in tumors of moderate size and still located in the pelvis than in tumors that are larger and that have grown out of the true pelvis and are supported by the pelvic brim. The correct explanation of the pain in the back, in my opinion, is that it is due to an excessive load put on the uterine ligaments, and not that it is due to pressure on the nerves. **Pain that is reflected down the legs, however, must be explained by pressure on the nerves.**

Hemorrhage.—The fibroma which causes hemorrhage is usually situated

beneath or near the endometrium. It may increase the amount, the duration, and the frequency of the menstruation, or it may cause a continual bleeding, resulting in a lowering of the general health, the patient being unable to recover from one menstrual period before the onset of another, and a severe secondary anemia. If the anemia is too marked, the patient should be given a period of rest, iron, and tonics before having an operation. **I performed successfully an hysterectomy on a patient with less than 20 per cent. of hemoglobin** resulting from a bleeding fibroma of the uterus. The bleeding was not checked by rest in bed, and an operation was necessary regardless of the anemia, but it was with a greatly increased risk.

Sterility.—Sterility is not infrequently an indication for operation for fibroma uteri, though it is not easy to define the exact relation between the tumor and the sterility. Out of 842 married women with fibromata of the uterus reported by Kelly and Cullen, 277 were sterile; but the condition of the tubes was doubtless the cause of the sterility in some of the cases. There is no doubt that a certain number of apparent cases of sterility have children after a myomectomy, and the indication, therefore, assuming that the case is one in which a myomectomy can be done, and in which there is no other apparent cause for the sterility, is to operate and remove the tumor. **In 94 cases reported by Kelly and Cullen, 1 became pregnant subsequent to a myomectomy.**

COMPLICATIONS OF OPERATIONS FOR FIBROMA UTERI

Injury to the Bladder.—The bladder is most often injured in opening the abdomen in the class of cases in which the bladder is attached to a tumor located in the anterior wall of the uterus and is drawn up in the abdomen by the growth of the tumor. This accident is avoided in 2 ways: (1) by remembering the rule always to open into the peritoneal cavity at the highest point of the abdominal incision, and (2) by recognizing the wall of the bladder as such, and not mistaking it for the peritoneum when it is exposed by the abdominal incision. Another point at which the bladder is sometimes opened is on the anterior wall and the cervix of the uterus. Usually at this point it is readily pushed off with a sponge, assisted by a few cuts with the scissors, but, if there has been any inflammation about it, the separation is more difficult and the bladder is sometimes injured. This is best avoided by care to work always in the anatomical layer between the bladder and the uterus, and by avoiding too great force. In a third class of cases, in which, as a result of an old inflammatory process, the organs are matted together, all landmarks may be obliterated and the bladder may be opened before it is recognized.

If the bladder is opened, it should be closed at once with a double row of fine interrupted catgut sutures, passing through all coats except the mucosa. As these injuries are, in practically all cases, situated in the upper part of the bladder and not at its base, the accumulation of a few ounces of urine in the

bladder will cause no harm and I prefer the use of a catheter every 3 to 6 hours to the continuous drainage of a self-retaining catheter. Usually the wound in the bladder heals kindly and does not interfere with the convalescence of the case.

Injury to the Ureters.—This injury should be even less frequent than injury to the bladder. It occasionally happens in one of 2 places. Sometimes at the side of the uterus the ligature on the uterine artery is so placed that it includes the ureter. Often, when the tumor grows out from the side of the uterus between the layers of the broad ligament, the ureter is displaced with it and it is sometimes injured. There is little excuse for including the ureter in the ligature on the uterine vessels. After the ligation of the infundibulopelvic and round ligaments on each side, an incision is made through the peritoneum and from one round ligament to the other. The bladder should be pushed down. This will expose the uterine vessels with the ureters below and to the outer side of them, and the vessels can then be safely ligated. The ureters are not seen, but the operator should positively determine that neither is included in these ligatures. He may not be able to see the ureters, but he can see that the ureter is not in the ligature. In intraligamentous fibroids the operator should keep constantly in mind that the ureter may be displaced and be able to recognize it if it comes into view.

[This practical caution should be borne in mind by all surgeons. The ureter may be displaced as high as the brim of the bony pelvis and may be tied off as an ovarian vessel. I was once on the point of doing it myself.—EDITOR.]

Secondary Hemorrhage.—This is an accident that may occur after any abdominal operation, but should not be frequent after either an hysterectomy or a myomectomy for fibroma uteri. At the end of the operation, before the abdomen is closed, each of the stumps should be examined and, if necessary, an additional ligature used. In a myomectomy, bleeding vessels should be caught and ligated as in other wounds, to control the bleeding, and the hemostasis not trusted entirely to the sutures. I had one case of secondary hemorrhage into the vagina from the cervical stump in a supravaginal hysterectomy. The wedge had been taken out of the stump to remove the cervical canal and the opening sutured, but evidently a vessel below the sutures was missed and continued to bleed. Bullet forceps were placed on the cervix in the vagina closing the external os and, as the blood could not escape either above or below, the hemorrhage at once ceased.

Injuries to the Intestines.—The intestines, as a result of old inflammatory action, may be adherent to the tumor and may be injured in separating the adhesions. The culdesac of Douglas not infrequently is obliterated by adhesions between the rectum and the tumor and the rectum may be injured in opening into the vagina. The intestinal injuries are much more frequent in vaginal operations than in abdominal and this is one of the strong arguments in favor of the abdominal operation except in a limited group of cases.

Phlebitis.—This is one of the most distressing sequelæ of operations for fibromata uteri. It develops between the tenth and seventeenth day after the operation, when the patient is otherwise doing well. That it is not due to infection is indicated by the fact that it is seen more frequently following operations for fibromata uteri, usually clean cases, than following operations for pyosalpinx, which are more often infected. It is more likely that it is due to change in the vessel wall itself.

CHOICE OF OPERATION

The choice between a vaginal and an abdominal operation for a fibroma uteri depends in general on the thickness of the abdominal wall, the size of the vagina, together with the amount of prolapse of the uterus and the number, size, and location of the tumors. With a large vagina associated with marked prolapse of the uterus, a tumor of moderate size can be easily removed, either with or without the uterus, through the vagina. If the woman has a thick abdominal wall, it can often be more easily removed by that route than by the abdomen. **If, on the other hand, the woman has never borne children and the vagina is small and without prolapse of the uterus, the removal of any tumor through the vagina is associated with great difficulty, and the abdominal route should be selected.** Between these 2 extremes, different operators vary in their choice of the route of attack, depending on their experience and early teaching and their general preference for the one route or the other. In general, the abdominal route is the easier and should be selected in most cases.

If an abdominal hysterectomy is performed, the choice between a supra-vaginal and a complete hysterectomy, that is, whether the cervix is to be removed or not, depends on the condition of the cervix and the necessity for drainage. If the cervix is lacerated, or if there is a suspicion of malignancy in it or in the fundus of the uterus, it is best to remove the cervix with the rest of the uterus. If the case demands drainage, the vaginal is the natural route, giving drainage downward, and is best obtained by removing the cervix. **Some operators remove the cervix as a rule on account of the possibility of cancer of the cervix.** The advantages of not removing the cervix are that less time is required for the operation, it leaves the floor of the pelvis stronger and with less possibility of prolapse of the vaginal walls, and the vagina is not shortened nor made more rigid, as is the case if the cervix is removed.

Myomectomy and Hysterectomy.—The choice between a myomectomy and an hysterectomy depends upon the value of the uterus to the patient. If we except single pedunculated tumors, either subperitoneal or submucous, and tumors so small that they give no symptoms and are removed only because exposed during the course of other operations, the mortality from an hysterectomy is less than that of myomectomy. **The functions of the uterus to be considered are that of child-bearing and the menstrual, with the possible mental and**

nervous symptoms due to their absence. If the patient is beyond the menopause, these functions no longer have to be considered and, therefore, an attempt to save the uterus is rarely indicated. During the child-bearing period in a patient who has had no children every effort should be made to save the uterus for obvious reasons. With a patient who has had the number of children she wishes, the preservation of the organ is less important, but it is still desirable on account of menstruation in a young woman. As a woman approaches the menopause, the risk of the mental and nervous disturbances due to the absence of the menstruation is less and there should be less effort made to preserve the uterus. The same reasoning should be used in the case where the ovaries or tubes have been removed. If both tubes have been removed, the uterus is of no value for child-bearing and should be preserved for menstruation only in women some years from the menopause. If both ovaries have been removed, no special effort should be made to save the uterus, as it is of no value either for menstruation or child bearing.

Even with the above factors in mind, it is often difficult to decide between an hysterectomy and a myomectomy. As a rule, nearly any single tumor can be removed without sacrificing the uterus, even though the tumor is of considerable size. Also, a large number of small tumors can be removed with safety. If there are a number of tumors and they have reached some size, then their removal leaves the uterus so mutilated that the risk is an unwise one to take.

Myomectomy during Pregnancy.—The removal of a fibrous polypus from the cervix is a simple operation and does not often interfere with pregnancy. Care should be taken, however, not to drag unnecessarily on the uterus nor to injure the membranes.

The removal of a subperitoneal or interstitial fibroid is an operation associated with considerable risk both to the patient and the pregnancy. Experience shows that most cases of pregnancy in a fibroid uterus go to term and are normally delivered without special difficulty. A tumor originally deep in the pelvis will often, either during the pregnancy or at the confinement, rise into the abdomen and offer no obstruction to the birth of the child. In the absence of symptoms demanding immediate interference, the indication, therefore, is to keep the patient under close observation and not to operate during the pregnancy, but at the confinement, if the child cannot be delivered by the natural passage, to do, shortly before term, a cesarean section and such additional operation as the case demands. This may be the removal of the uterus, if there are a large number of fibromata, or a myomectomy if the number is small and they are favorably located.

A number of cases of myomectomy during pregnancy have been reported in the literature with a moderate maternal and fetal mortality. I have had 3 such cases in the early months of pregnancy with neither maternal nor fetal death. The probabilities are that, as in my cases, the abdomen was opened under a mistaken diagnosis, under the belief that the patient was not pregnant or that the growth was an ovarian cyst. With the exception of large pedunculated

tumors, the cases in which the abdomen should be opened are very few. When the abdomen has been opened and such a condition found, whether it is better to do a myomectomy or to do nothing depends on the case. If the tumor is pedunculated, the risk either to the mother or the child is small, and the growth should be removed. If the growth is single or if there are a small number, favorably located close to the peritoneum, they can be removed with small risk, and this is usually indicated. Otherwise, it is best to wait until after the pregnancy is over and to do the myomectomy at a future time. In any case, care must be taken not to handle or manipulate the uterus except as absolutely necessary, otherwise premature labor may be induced.

Conservation of Ovaries.—Opinions differ as to the treatment of the ovaries when an hysterectomy is done for fibromyoma of the uterus. There is no doubt that the artificial menopause produced by the removal of the ovaries is followed in a certain number of cases by a train of nervous symptoms more distressing and more difficult to treat than those of the tumor requiring the hysterectomy. It is my opinion that the number of cases of this kind is smaller than the statements of some writers would lead one to suppose. It must also be remembered that to leave the ovaries may be associated with some disadvantages. The ovaries are delicate organs, frequently the seat of inflammatory lesions and often the cause of subsequent pain and discomfort. To remove the ovaries, then, is associated with the risk of distressing symptoms of the artificial menopause; not to remove them is associated with the risk of subsequent pain and discomfort due to the presence of organs prone to get into trouble. The risk of trouble due to the artificial menopause is greater the younger the patient. The risk of trouble from the presence of the ovaries is greater if there has been previous inflammation or other disease in them, or if, on account of adhesions or other cause, they have been injured during the operation. These factors, the age of the patient and the condition of the ovaries, are to be considered in determining whether or not the ovaries should be removed. The younger the woman with normal ovaries the greater the incentive to conserve these organs, the more advanced in years the patient, particularly if the ovaries are not normal, the less should be the attempt to save them.

As a general working basis, it is my custom, with a patient under 35 years of age, to save both ovaries if they are normal, one ovary if one is normal and the other diseased or injured, or even part of one ovary if they are both diseased.

A resected ovary is more apt to cause trouble than one that has not been injured. It is better sometimes to leave an ovary somewhat enlarged and cystic rather than to resect it. If the patient is beyond 45 years of age, little or no attempt should be made to save either ovary. If the ovaries are not removed, they should be so sutured to the round ligaments that they will have ample support to keep them from falling down into the culdesac. **An ovary that is not properly supported gives pain.**

The operations for fibroma myomata uteri may be classified as follows:

A. Vaginal.

1. Myomectomy (including the removal of polypi).
2. Hysterectomy.
 - a. Supravaginal.
 - b. Complete.

B. Abdominal.

1. Myomectomy.
2. Hysterectomy.
 - a. Supravaginal.
 - b. Complete.

VAGINAL MYOMECTOMY

Indications.—The polyp that projects down into or through the cervix naturally should be removed through the vagina. The submucous or subperitoneal fibroids, if not too large in size or too numerous, can be removed through the vagina, though the operation usually is more difficult than removal through the abdomen. The size of the vagina and the mobility of the uterus are factors of as great importance as the size and number of tumors in deciding upon a vaginal myomectomy. Care should be taken not to extend the indications for a vaginal myomectomy too far, on account of the possibility of injury to surrounding organs and the danger of hemorrhage.

Technic of Operation.—The removal of a polyp that projects down to or through the external os is simple. The tumor is grasped in double volsellum forceps and gradually twisted with a little traction, and thus easily removed. If the polyp is attached by a pedicle of such size that the tumor does not come off readily with twisting, then it can be cut a little with scissors and the traction continued. It is well to make the incision in the pedicle close to the tumor rather than close to the uterus, in order to avoid the possibility of injury to the uterine wall. If there are any ragged edges of the tumor capsule, they can be cut off subsequently. Great traction should not be made in these cases, where the pedicle is large, otherwise the uterus may be perforated or inverted in removing the tumor.

REMOVAL OF SUBMUCOUS FIBROIDS.—To remove a submucous fibroid, it is necessary to have access to the interior of the uterus. This can be obtained in one of 2 ways, either through the cervical canal or by dividing the anterior lip of the cervix and a part of the anterior wall of the uterus. The former method can be used only when the canal is open or can be easily dilated. It is always an obscure and uncertain method, and it is not often to be recommended. The latter method gives an excellent view of the uterine cavity, allowing work to be done directly under the eye and is the preferable method to use in most cases.

This operation is performed as follows: The anterior lip of the cervix is grasped by 2 single bullet forceps, 1 on either side of the middle line, and drawn well down toward the vulva. A vertical incision through the mucous membrane is made in the anterior wall of the vagina reaching from the cervix to within 1 or 2 in. of the meatus urinarius. After the mucous membrane has been divided, the flaps are dissected back, 1 on either side, to expose the fold of the

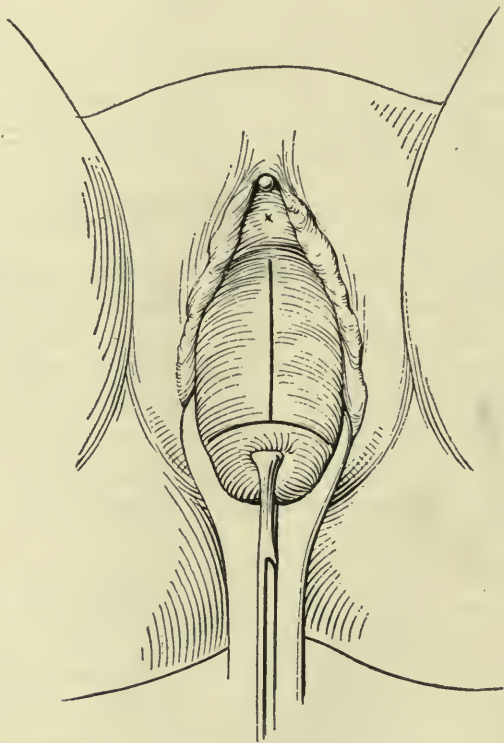


FIG. 1.—LINES OF ANTERIOR VAGINAL INCISION.

bladder. The bladder fold reaches to within 1 or $1\frac{1}{2}$ in. of the lower end of the cervix uteri and must be recognized when it is reached so that it will not be injured. To pass the sound into the bladder in order to outline the position of the fold is unwise, as it is associated with some risk of injury to the bladder mucous membrane and, furthermore, it can easily displace the bladder and not give its true limitation. After dissecting back the lateral vaginal flaps, the separation of the bladder should begin low on the cervix and the dissection should be as close to the uterus as possible without entering the uterine tissue itself. After the first inch of dissection, if the proper anatomical plane is entered, the bladder can easily be separated from the uterus with a sponge or the finger without further cutting until the peritoneum is reached. In case more room is needed than is given by the vertical incision through the vaginal wall,

a transverse incision from the cervical end of the vertical incision can be made, extending part way around the cervix. This will give ample room for any case suitable for a vaginal myomectomy. The bladder must be separated from the uterus and pushed up so that it will not be injured in dividing the uterus. It will usually be necessary to push it high enough so that the peritoneal fold is reached and the peritoneal cavity exposed.

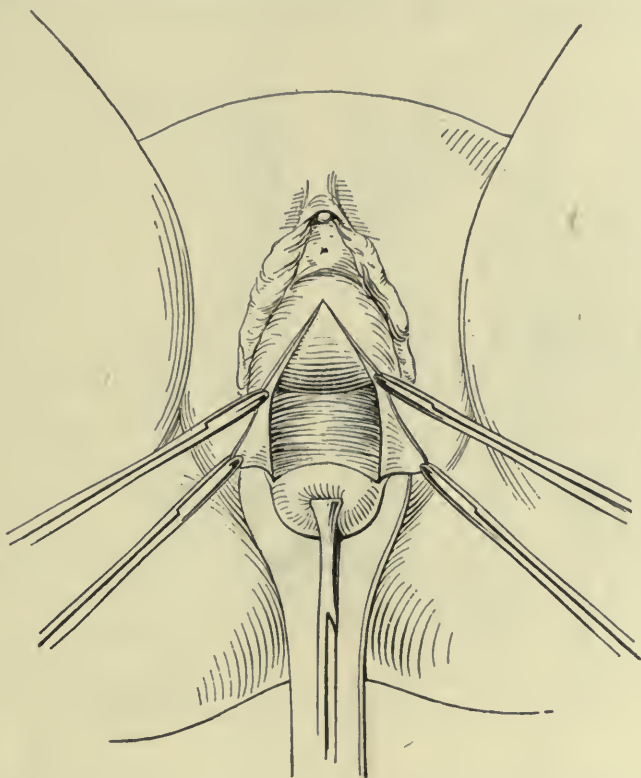


FIG. 2.—ANTERIOR VAGINAL FLAPS DISSECTED BACK EXPOSING BLADDER.

After the bladder is pushed out of the way, the anterior lip of the cervix and the anterior wall of the uterus are divided between the 2 bullet forceps as high as may be necessary. As this incision is carried upward, the bullet forceps should be removed from the cervix and 1 put on either side of this vertical wound in the uterus, so that the fundus can be drawn forward while the cervix is pushed back toward the hollow of the sacrum. This point must surely be remembered. Except with great relaxation of the parts, it is not possible to turn the uterus out into the vagina or properly expose it if the cervix is held close to the vulva. The uterus is a more or less rigid body supported largely on a transverse axis just below its middle point. If the cervix is drawn forward, the fundus is turned back. If, on the other hand, the cervix is pushed back, the fundus comes forward more easily. Neglect of this point often adds greatly

to the difficulty of the operation. The incision in the wall is carried through into the cavity of the uterus. The interior of the uterus is thus exposed and can be explored with the finger and such operative interference as may be necessary carried out.

To remove a submucous fibroid an incision through the mucous membrane and the capsule of the tumor is made with the knife, the tumor is seized with a sharp hook and drawn forward, and as it is drawn outward the capsule is

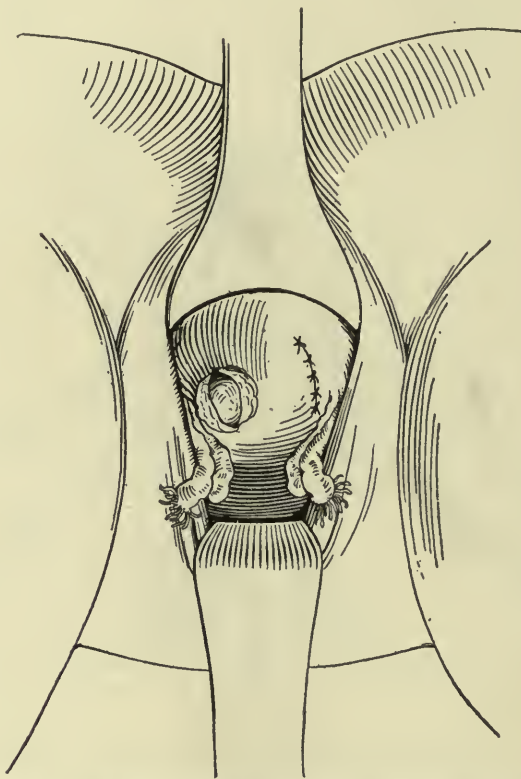


FIG. 3.—UTERUS DELIVERED INTO VAGINA; MYOMECTOMY.

pushed back with a pair of scissors, occasionally cutting some of the fibrous bands which hold it in place, and the tumor is entirely removed. The cavity left after the removal of the tumor should be carefully sutured so that there will be no bleeding and no pocket for the accumulation of fluid to become infected. One or more submucous fibroids may be removed in this way. After the tumors have been removed, the uterus is sutured, the bladder allowed to drop down in its place, and the incision through the vaginal membrane sutured back in place. It is not necessary to put any drainage in the uterus following such an operation. In fact, gauze put into the interior of the uterus for drainage is more apt to interfere with drainage than to help it.

REMOVAL OF SUBPERITONEAL FIBROIDS.—To perform a vaginal myo-

mectomy for a subperitoneal fibroid, the uterus is exposed in the same way, but the incision is not made into the cavity. The uterus is drawn down by bullet forceps inserted into the cervix, the vertical incision through the vaginal mucous membrane is made, supplemented, if necessary, by a transverse incision at its cervical end, the bladder is pushed up, and the peritoneal cavity is opened. If the fibroid is in the anterior wall of the uterus, it is not necessary to deliver the fundus of the uterus into the vagina, as the fibroid will be well exposed without doing so and can be easily removed. If, however, the fibroid is in the posterior uterine wall, then the fundus should be turned out into the vagina in order to give proper access to the tumor. To remove the fibroid, an incision is made over the tumor with a knife, care being taken to go through its capsule, and the tumor itself is exposed. The tumor is then seized with a sharp hook and drawn outward and enucleated with the scissors. Each cavity that is left by the removal of the tumor should immediately be sutured, using care to leave no dead spaces and to control all bleeding. To diminish the chance of adhesions, the peritoneum should be injured as little as possible and as many of the fibroids as possible should be removed through a single incision in the uterine wall. After the various fibroids have been removed, the uterus is replaced in the abdominal cavity and the vaginal wound sutured.

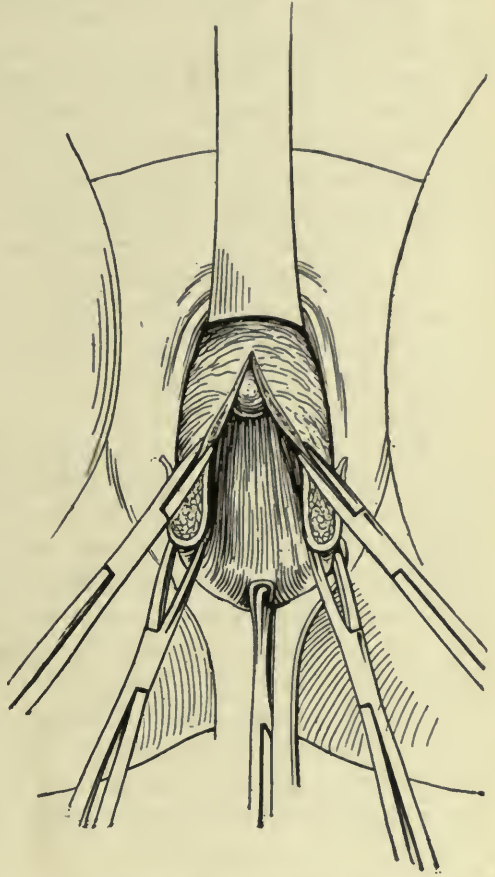


FIG. 4.—CERVIX AND ANTERIOR VAGINAL WALL DIVIDED EXPOSING SUBMUCOUS FIBROMA UTERI.

VAGINAL HYSTERECTOMY

Indications.—A vaginal hysterectomy was performed relatively more frequently in years past, when the danger of opening the abdomen was greater and was undertaken with more fear. Formerly the danger of a hernia through the abdominal wound was an additional reason for doing a vaginal hysterectomy when it could be conveniently performed. At the present time most operators

prefer to do an hysterectomy through the abdomen rather than through the vagina even when the uterus is not materially increased in size. If the hysterectomy is performed through the abdomen, the cervix can be left and any shortening of the vagina avoided. If the hysterectomy is done through the vagina, the cervix is ordinarily removed, and this will produce at least some shortening and a certain rigidity of the upper end of the vagina.

There are, however, certain definite indications for performing a vaginal hysterectomy for fibroma of the uterus. If the patient is a large, fat woman then an abdominal hysterectomy is much more difficult than in a thin woman, and in such a patient, assuming that the vagina is large, the vaginal hysterectomy should be selected as the preferable operation. There is no question that there are less shock and less general disturbance to the patient in a vaginal hysterectomy than in the ordinary abdominal hysterectomy. Therefore, a vaginal hysterectomy is the better operation for a patient who is advanced in years or who is in bad condition for any cause, assuming that the vagina is of reasonable size.

Before deciding to do a vaginal hysterectomy, there are 3 things to be carefully considered: the thickness of the abdominal wall, which is an important factor in deciding the ease with which an abdominal hysterectomy can be done; the relaxation of the vagina, together with any prolapse of the uterus, which is an important factor in determining the ease with which a vaginal hysterectomy can be done; and the size of the uterus with the tumor which it contains.

If there is marked relaxation of the vaginal outlet and partial or nearly complete prolapse of the uterus, the removal of the organ through the vagina is a very simple operation. The removal of the uterus, if there is no prolapse and no relaxation of the vagina, is often an operation of great difficulty. Just when the size of the uterus and the relaxation of the vagina should indicate a vaginal rather than an abdominal hysterectomy must be left to the individual judgment of the operator.

It must, however, be borne in mind that a vaginal hysterectomy is a more difficult operation than an abdominal hysterectomy, and even in the hands of a skillful operator a vaginal hysterectomy may have to be changed to an abdominal hysterectomy on account of bleeding or possible injury to the surrounding organs.

Technic of Operation.—There are 3 general methods of doing a vaginal hysterectomy with which the surgeon should be familiar, depending on the amount of mutilation of the uterus during its removal. In a uterus of moderate size with a certain amount of prolapse and a vagina not too small, the uterus can be removed without any mutilation whatsoever. If it is removed with more difficulty on account of its size or the size of the vagina, then it is best to bisect the uterus before removing it. In a still larger case, the uterus with its tumor can be removed only by dividing it into relatively small pieces, that is, by morcellement.

The removal of the uterus without any mutilation of it will be described first and then such modifications of this operation as may be necessary to bisect the uterus or to remove it by morecellement.

REMOVAL OF THE UTERUS WITHOUT MUTILATION.—The cervix is seized on its anterior and posterior lips by a double bullet forceps (which closes the cervical canal and prevents any discharge from it) and drawn downward toward the vulva. The first incision is a circular one around the cervix 2 or 3 cm. above the external os. If more room is desired, it can be obtained by a vertical incision in the middle line of the anterior vaginal wall extending from the circular incision downward toward the urethra. The vaginal mucous membrane is then pushed upward with a sponge on both the anterior and posterior surfaces of the uterus. If the circular incision around the cervix is carried to the right depth, striking the proper anatomical layer, the tissue can be easily pushed off with little cutting. This will bring into view at each side of the uterus the bases of the broad ligaments containing the lower branches of the uterine vessels. These should be ligated and the tissues divided between the ligature and the uterus.

The cervix is next drawn markedly forward and the culdesac of Douglas opened from one uterosacral ligament to the other. One finger is now introduced into the culdesac through this opening to protect the intestines from being injured by the needle, and each uterosacral ligament ligated and divided. Usually the uterosacral ligaments hold the uterus from coming down, and after they have been divided the uterus will come within more easy reach. The cervix is now drawn downward and backward, the bladder pushed off the anterior surface of the uterus and the peritoneal cavity opened in front of the uterus. It is possible now with one finger through the posterior opening into the peritoneal cavity and another in the anterior opening to palpate definitely the base of the broad ligament containing the uterine vessels and these should be ligated at the side of the uterus and divided. This will allow the uterus to come down still more, bringing within reach the round ligaments and the tubes and ovaries.

The round ligaments are exposed in front and each ligated. If the tubes and ovaries are to be removed, they should be drawn down and the infundibulopelvic ligaments ligated outside each ovary. If the tubes and ovaries are not to be removed—and in some cases it is better not to remove them, as it is not always easy to expose the infundibulopelvic ligaments—they can be ligated close to the uterus and the tissue divided and the uterus entirely removed.

REMOVAL OF THE BISECTED UTERUS.—In a more difficult case, that is, when the uterus with the tumor is larger or the vagina is smaller, it is best to bisect the uterus before removing it. The operation is started the same way as when the uterus is removed without mutilation. A circular incision is made around the cervix, the anterior and posterior vaginal walls are pushed away from the uterus, and the peritoneal cavity is opened in front and behind. The anterior lip of the cervix is seized by 2 pairs of bullet forceps, 1 on either side

of the middle line, and the cervix and the lower part of the anterior wall of the uterus are divided with a knife or with scissors one blade of which has been passed into the interior of the uterus. The bullet forceps are then changed and one fastened into each cut surface of the uterus. These will pull the uterus down a little further and the incision is carried still higher. The bullet forceps are again changed to higher points, the cervix pushed back toward the hollow

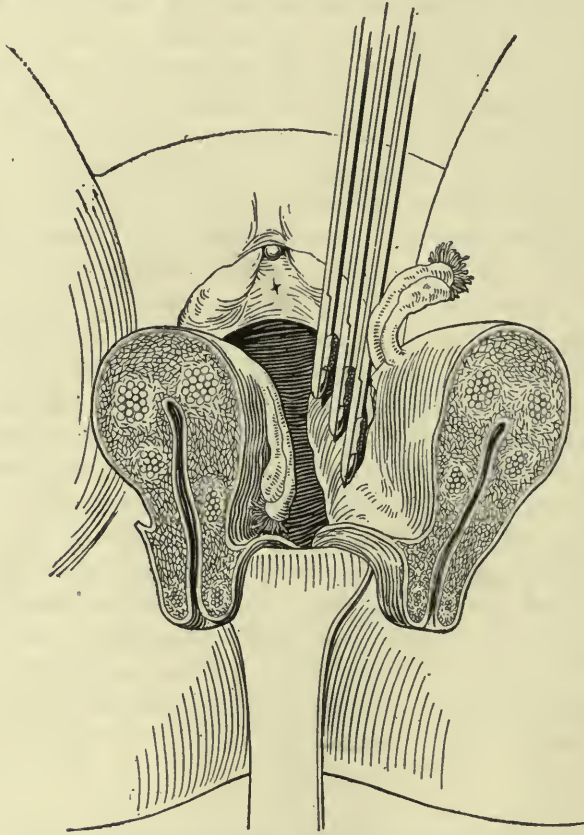


FIG. 5.—UTERUS BISECTED; VAGINAL HYSTERECTOMY.

of the sacrum, and this continued until the fundus of the uterus is entirely divided, that is, the incision is carried up the anterior surface and then down the posterior, leaving the uterus divided into 2 equal parts. There is usually little or no active bleeding, as it is controlled by the traction on the forceps. If there is any bleeding, it can easily be controlled by forceps seizing the entire thickness of the uterine wall until the vessels are clamped. It is sometimes easier, after the anterior wall of the uterus has been entirely divided, to begin back again at the posterior lip of the cervix and divide the posterior wall of the uterus in the same way until it meets the incision that was made in the anterior surface, that is, an incision through the anterior wall is carried from the cervix up to the fundus, and then, starting back at the cervix, an incision is carried

through the posterior wall to the fundus. After the uterus has been bisected in this way, the vessels should be clamped and first one-half of the uterus and then the other removed. The first clamp should be put on the lower part of the broad ligament including the uterine vessel. The tissue between this clamp and the uterus is then divided with the scissors. A second clamp is put on above the one already on, including the round ligament, and again the tissue between this and the uterus is divided. A third clamp includes the tube and the utero-ovarian ligament if the tubes and ovaries are not to be removed, or the infundibulopelvic ligament if they are to be removed, and the uterus is cut away. After one half of the uterus is removed, then the other half should be treated in the same way. After the uterus has been removed, there will be ample room for ligating the tissue included in the clamps and removing them. The subsequent treatment and closure of this wound will be the same as when the uterus is removed without mutilation and will be described later.

REMOVAL OF THE UTERUS AFTER MORCELLEMENT.—If the uterus and tumor are too large to be turned out of the vagina, it is necessary before doing so to diminish their size by morcellement. The cervix is drawn well down, a circular incision is made around the cervix, as in the preceding operation, supplemented by a vertical incision in the middle line on the anterior vaginal wall if necessary. The bladder is pushed away from the anterior surface of the uterus and the peritoneal cavity opened. The lower part of the uterus and the cervix are divided between double bullet forceps as in the previous operation. After the uterus has been divided as far as it can conveniently be brought into view, these exposed parts of the uterus and tumor are removed with the knife. A wedge-shaped piece is then removed from the presenting part, and as one piece of uterus or tumor is removed another will come into view and can be seized with the bullet forceps and drawn down and another wedge removed. One piece after another is removed until the uterus is so reduced in size that it can be delivered into the vagina from the abdominal cavity. The traction kept up on the uterus is sufficient to control the bleeding, so that there is ordinarily no disturbance from hemorrhage in removing the pieces of the tumor or uterus in this way. After the uterus has been so decreased in size that it can be turned into the vagina, it is then either bisected and removed after the application of clamps, as in the preceding operation, or the clamps are put on without bisecting the uterus.

It is at times more convenient to apply the clamps from above downward than from below upward, that is, the first clamp is put on the tube and the utero-ovarian ligament or on the infundibulopelvic ligament and the tissues divided, the second clamp on the round ligament and the upper part of the broad ligament and the third clamp on the lower part of the broad ligament, including the uterine arteries. After the uterus is removed, the tissues in the clamps are ordinarily ligated one at a time and removed.

CLOSURE OF THE WOUND.—The subsequent treatment of the wound is the same in all 3 operations. The line of sutures in each should be carefully

examined to be sure that there are no bleeding points. It is desirable then to cover over all raw surfaces, as far as possible, with peritoneum and to diminish or close the opening in the top of the vagina. The peritoneum which was dissected off the anterior surface of the uterus is drawn down and sutured for a distance of 4 to 6 cm. to the cut edge of the top of the anterior wall of the vagina. In the same way the peritoneum from the culdesac behind is drawn

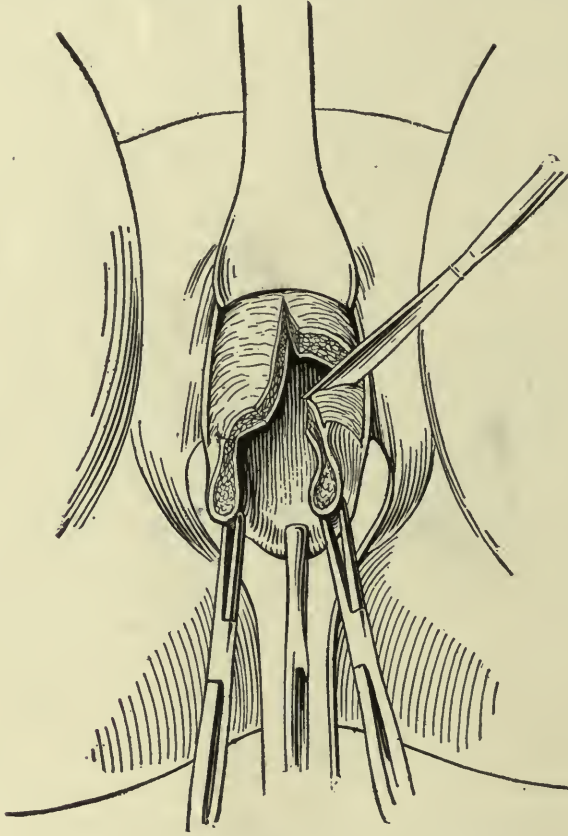


FIG. 6.—VAGINAL MYOMECTOMY BY MORCELLEMENT.

forward and sutured to the cut edge of the posterior wall of the vagina for a distance of 4 to 6 cm. The infundibulopelvic ligament of each side, if it is long enough, should be drawn down and attached to the top of the vagina on the corresponding side. This is to assist in covering the raw surfaces on the side, which it is otherwise not easy to do, and also to act as additional support to the vagina. The anterior and posterior walls of the vagina are then brought together with 3 or 4 interrupted sutures. The top of the vagina at each angle may be left open and a very small piece of gauze inserted for drainage if there is any indication for it. The indication for drainage would be injury to one of the surrounding organs, such as the bladder or intestine, soiling of the pelvic

peritoneum by an abscess of the ovary or tube or by a necrotic and broken-down fibroma of the uterus, or a remnant of necrotic tissue not easy to remove.

VAGINAL SUPRAVAGINAL HYSTERECTOMY

Indications.—The indications for this operation are few, being limited largely to cases of prolapse of a fibroid uterus with cystocele in which it is desirable to retain the cervix as an anchorage for the bladder and anterior vaginal wall. The operation is not indicated if the tumor is of such size that it can not be delivered into the vagina through the incision in the anterior vaginal fornix.

Technic of Operation.—The uterus is exposed by the median incision in the anterior vaginal wall, supplemented by curved incisions around the front of the cervix if it is necessary, and is delivered into the vagina. The round ligaments are ligated close to the uterus and divided. Ligatures are placed on the infundibulopelvic ligaments if the tubes and ovaries are to be removed, on the tubo-ovarian and the tubo-uterine ligaments if the ovaries are to be saved. The ligaments that have been ligated are divided and also the broad ligaments close to the uterus down to the level of the internal os. At this point the uterine vessels are ligated and then the fundus of the uterus is amputated. A wedge including the cervical canal is removed from the cervix, and the cavity left is closed by interrupted catgut sutures. The 2 layers of the broad ligament on each side are brought together with catgut sutures, and the infundibulopelvic and round ligaments on each side sutured to the cervical stump. The bladder fold of peritoneum which was dissected from the anterior surface of the uterus is sutured to the peritoneum on the posterior surface of the cervix. The cervix itself is sutured under the bladder to the anterior vaginal wall and the vaginal incisions closed as the treatment of the prolapse of the vaginal wall demands. Ordinarily no drainage is necessary.

ABDOMINAL MYOMECTOMY

Indications.—The abdominal route is used for all cases of myomectomy excepting those exceptional cases outlined under vaginal myomectomy. All doubtful cases where there is a question whether a myomectomy is possible or an hysterectomy is necessary should be approached through the abdomen, as it gives a much better opportunity to determine the nature of the operation necessary.

Technic of Operation.—The transverse incision of Pfannenstiel should be used when an incision of not over 12 cm. in the median line is required to remove the tumor. The advantages of the transverse incision, however, do not seem to me to be sufficient over the ordinary median incision to warrant dividing the tumor into pieces and removing it piecemeal as is advised by some au-

thors. If the tumor is one requiring an incision more than 12 em. in length, then it is better to use a median incision long enough to remove the tumor whole, because it is not possible to determine positively that the tumor has not undergone some degenerative change which might increase the chances of infection if the degenerated material were spread over the abdominal cavity.

There are several rules to be remembered in doing a myomectomy. To diminish the chance of adhesions from injury to the peritoneum, as many fibroids as possible should be removed through a single incision instead of

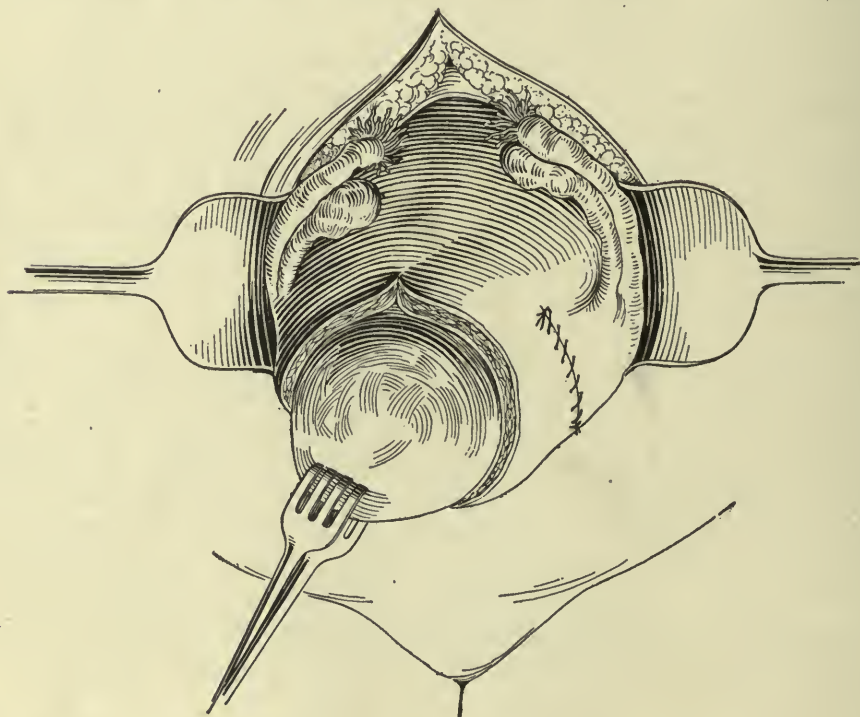


FIG. 7.—ABDOMINAL MYOMECTOMY.

making an incision for each fibroid. The incision should be as near the middle line as possible, as the vessels there are smaller and the hemorrhage less. Neither an incision on the anterior nor on the posterior wall nor an independent incision should extend to the top of the fundus unless necessary, as often, following a myomectomy, the uterus has to be suspended, and if there is an incision on the top of the fundus and it comes in contact with the abdominal wall, a fixation may be formed to cause trouble with a subsequent pregnancy or confinement. For obvious reasons, the incision must avoid the uterine ends of the tubes.

If the tumor is largely subperitoneal, there is a temptation to make an oval incision about it, sacrificing a part of its peritoneal covering. This is unwise, as the amount of contraction of the flaps is hard to estimate. The better inci-

sion is a straight one over the tumor. After this has been removed, any superfluous tissue can be cut away with the scissors. Bleeding points should be clamped and ligated as in any other wound and not left to be controlled by the sutures. If the uterine cavity is opened in removing a fibroid, no harm is done, and it can be closed with sutures with the rest of the wound.

Mackenrodt recommended that, in the case of the removal of a large fibroma with a resulting large cavity, any opening into the uterine cavity should not be sutured but left open for drainage through the uterus into the vagina.

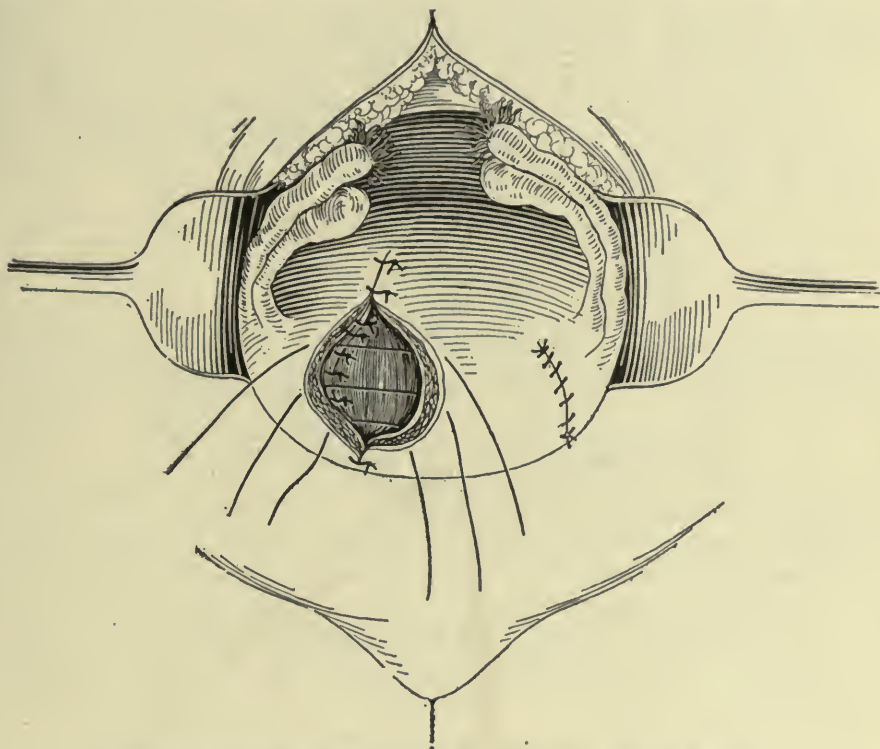


FIG. 8.—ABDOMINAL MYOMECTOMY; CLOSURE OF UTERINE WOUND.

Before opening the abdomen of a case in which a myomectomy will probably be done, the cervix should be dilated and the uterus curetted and washed out with a weak iodine solution. This insures a clean endometrium and an open cervix for drainage if the uterine cavity is opened during the removal of the fibroid and there is any subsequent oozing into the cavity of the uterus.

After the abdomen is opened by a transverse or median incision, as the extent of the case demands, the uterus is drawn forward into the wound by bullet forceps fastened to one of the fibroids. This is used to steady the uterus while the fibroids are removed. The removal of a fibroid from the uterus is easy if the proper layer is reached, much more difficult if the dissection is made out of this layer. To surely be in the right layer, the incision in the uterus

should be carried through the capsule and into the tumor itself. The tumor is seized with a pair of bullet forceps and, as traction is made on it, it can easily be separated from its capsule with the scissors or finger. All bleeding points should be ligated and the wound closed with fine catgut.

If the fibroid tumor has been a large one or if it has been so placed that the uterus is displaced materially from its normal position, then its ligaments have been overstretched and care should be taken that the uterus shall not permanently assume an abnormal position. If the uterus is found to be specially movable, dropping back into the culdesac, then it should be treated at this time as a retroverted uterus and suspended in its normal position either by using the round ligament through the recti muscles, as described by Gilliam, or by using the round ligaments attached to the back of the uterus, as described by Baldy and Webster, supporting the uterus in its normal position. The abdominal wound is then closed without drainage.

ABDOMINAL HYSTERECTOMY

The supravaginal hysterectomy will be described first, and afterward such modifications and additional work as are necessary for the complete hysterectomy.

SUPRAVAGINAL HYSTERECTOMY

Technic of Operation.—In a simple typical case 3 ligatures only are needed on each side, 1 on the infundibulopelvic ligament, 1 on the round ligament and the third on the uterine vessels. These 3 ligatures on each side will control all the real bleeding if properly placed, in a large number of cases. After the abdomen is opened, the fibroid is seized with heavy volsellum forceps and, if possible, raised out of the pelvis and sometimes entirely out of the abdominal cavity. If the uterus is fixed either through adhesions or inflammatory induration about the bases of the broad ligaments, then it will not be possible to raise the uterus, and it will be necessary to put on the ligatures with the tumor in place. This adds considerably to the difficulty of the operation as the vessels are less accessible. Any adhesions about the tubes and ovaries are separated and the uterus with the tube and ovary of one side is drawn toward the opposite side, exposing the infundibulopelvic ligament, which is ligated with catgut. The round ligament of the same side is then ligated about 2 cm. from the uterus. A clamp is placed on the broad ligament, including the utero-ovarian and round ligaments near the uterus, and the infundibulopelvic and round ligaments with the intervening broad ligament are divided with the scissors. The uterus is then drawn to the opposite side and the same ligaments ligated and divided on the other side. An incision is then made across the front of the uterus from one round ligament to the other, separating the bladder fold of peritoneum from the uterus, and the bladder is pushed down with a gauze sponge, exposing

the uterine vessels on each side. These vessels are next ligated, first on one side and then on the other, and divided with the scissors. If these ligatures are put on properly, they will control all the bleeding. The ligatures on the uterine vessels should pass between them and the uterus. If they include any uterine tissue, it will prevent the easy separation of the vessels from the cervix if it is

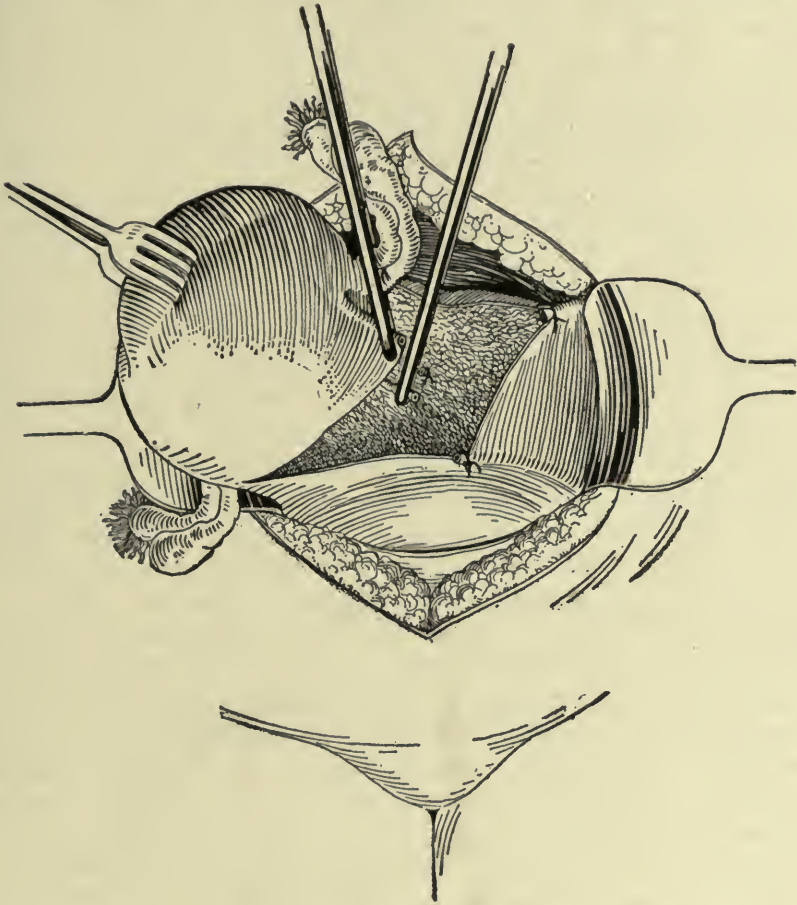


FIG. 9.—ABDOMINAL HYSTERECTOMY.

desired to do a complete hysterectomy. If they are not placed near enough to the uterus, they may pass through a vein or fail to include the vessels and there may be troublesome bleeding. The cervix, below the ligatures placed on the uterine vessels, is next seized in front with a bullet forceps to steady it, the hand is passed back of the uterus so that the intestines are protected from injury of the knife and the fundus of the uterus amputated. It is not necessary to divide and push down the peritoneum on the posterior surface of the uterus before removing it. If at this stage there are any bleeding points, they should be caught and ligated.

There are 2 methods of treating the cervical canal in the stump before closing over the peritoneum. One is to destroy it with cautery and the other is to remove it by taking out a wedge of the cervix with the knife, including in the wedge the cervical canal. The latter is by far the better method.

To attempt to destroy it with the cautery means that the vitality of tissue which is not destroyed is lowered and that there may be delay in healing. A wound made with a knife does not lower the vitality of surrounding tissue as one made with a cautery, and it is far better to use it here as elsewhere when possible. It is well to remove the cervical canal well down toward the external os, as it may be the cause of discharge which will be difficult to control. After the wedge has been removed from the cervix, it is drawn together with 3 or 4 interrupted sutures of catgut.

Next the bladder fold of the peritoneum, which has been pushed down from the front of the uterus, is sutured over the top of the cervix to the peritoneum on its posterior surface. This suture, beginning in the middle line, is carried outward, bringing together the anterior and posterior layers of the broad ligament as far as the infundibulopelvic ligament, first on one side and then on the other, working in each case from the middle line outward rather than from the infundibulopelvic ligament inward toward the cervix, because in suturing these 2 layers together the broad ligament, including the round ligament and if possible the infundibulopelvic ligament, should be puckered down to the cervix in order to give the stump support and lessen the chance of its becoming prolapsed. This is particularly necessary if there has been any tendency of the uterus to prolapse, as is often the case in fibroid of the uterus.

Modifications.—There are 2 modifications of the above typical hysterectomy, which will frequently be of distinct assistance.

In some cases, when the tumor is of considerable size and grows out from the side of the uterus, the vessels to be ligated are within easy reach on one side but those on the other side are quite inaccessible. In such a case it is easier to go down on one side, across the cervix, and up on the other side, that is, the ligatures are placed in the following order, first on the accessible infundibulopelvic ligament, then on the round ligament, and finally on the uterine vessels of one side. The cervix is then cut across and the vessels on the opposite side are ligated in the reverse direction, that is, the uterine vessels, the round ligament and the infundibulopelvic ligament. It will be found, in working from below upward, that as one set of vessels is ligated and divided, the next will come within easy reach.

There is another class of cases in which, on account of the size or the position of the tumor or on account of disease in the appendages, it is not easy to expose either infundibulopelvic ligament. It is best in these cases to clamp or ligate the tubes and ovaries close to the uterus, cut them from the uterus, and let them drop back in the abdomen and then to proceed with the operation as described above to remove the uterus. After the uterus has been removed, the tubes and ovaries are easily seen and can be removed with much greater ease

and with less danger of injury to the intestines than if their removal had been attempted previous to removing the uterus.

In cases of this kind some operators advise bisecting the uterus in the middle line, down to the internal os if a supravaginal hysterectomy is to be done, and down to the vagina if the cervix is to be removed; then to remove first one half of the uterus and then the other, working from below upward. The uterus is seized with 2 heavy volsellum forceps, 1 on each side of the middle line, and is drawn into the wound. An incision is made in the middle line opening the uterine cavity. First one uterine wall and then the other is divided, as is most convenient, down to the internal os. On the anterior uterine wall care must be taken not to injure the bladder. At the level of the internal os the uterus is divided transversely. This will expose the uterine vessels, which should be ligated or clamped and divided. This incision through the peritoneum and broad ligaments is carried upward to the round ligament, which should be ligated and divided.

This half of the uterus is then attached only by the infundibulopelvic and upper part of the broad ligaments. A ligature or clamp should be placed on the infundibulopelvic ligament and the remaining attachments divided. The other half of the uterus is then approached in the same manner and removed. The vessels, on which any clamps may have been placed, are ligated and the clamp removed. The case is then completed as has been described under supravaginal hysterectomy.

COMPLETE ABDOMINAL HYSTERECTOMY

Technic of Operation.—A typical complete hysterectomy for a fibroma uteri is the same as a typical supravaginal hysterectomy as far as the ligation and division of the uterine vessels. The infundibulopelvic and round ligaments are ligated and divided. The bladder reflection of peritoneum is incised and the bladder pushed down, the uterine vessels are ligated and divided, but the cervix is not cut across. This will ordinarily allow the uterus to come well up into the abdominal wound. It will probably be necessary to put another ligature on the base of each broad ligament below the ligature put on the uterine vessels, in order to control the branches of those vessels running downward towards the vagina. The tissue between these ligatures and the cervix is divided, and the uterus is then held only by the walls of the vagina. The vagina is usually opened through its anterior wall. The bladder having been pushed well down, the anterior wall of the vagina is seized with a pair of bullet forceps and an incision made into it with the scissors. After the opening has been made into the vagina, the incision is extended around the cervix and the uterus removed. There will usually be some bleeding from small vessels in the cut edge of the vagina, which should be caught and ligated or included in the sutures uniting the vaginal walls to the peritoneum.

There are some cases when, on account of inflammation, it is not easy to

push down the bladder sufficiently to be sure that it will not be injured if the vagina is opened through its anterior wall. In these cases it is best to make the first incision into the vagina either at the side or posteriorly below the cervix.

If the first incision into the vagina is to be made at the side, a second or even a third ligature may be placed on the base of the broad ligament below the ligated uterine vessels and the intervening tissue divided. The vagina can then be opened without fear of injury to the surrounding organs. The rectum is well behind and out of the way. The ureter is outside of the ligature placed on the uterine vessels and passes to the bladder in front. The bladder is in

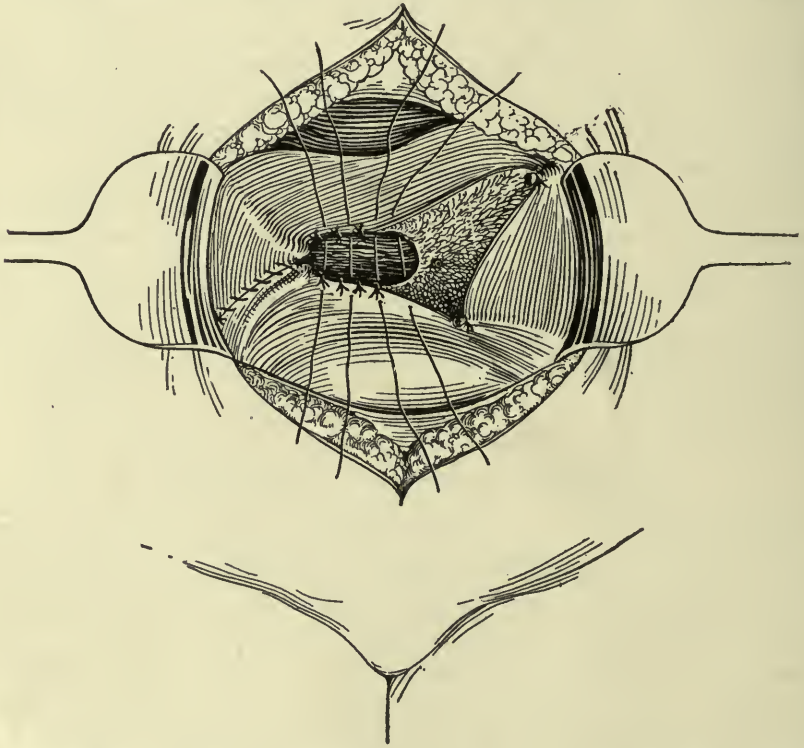


FIG. 10.—COMPLETE ABDOMINAL HYSTERECTOMY; SUTURE OF VAGINA AND BROAD LIGAMENTS.

front and there is no danger of reaching it. After the vagina is opened in one place it can be incised around the cervix and the uterus removed.

Another method of entering the vagina is first to amputate the fundus of the uterus and then bisect the cervix and remove each half separately. After all the vessels, including the uterine, have been ligated and divided, the uterus is removed at the level of the internal os as in a supravaginal hysterectomy. This makes the cervix much more accessible and it is easier to see its relations. The cervix is seized by 2 bullet forceps, 1 on either side of the middle line. With a pair of scissors, one blade of which is inserted into the cervical canal, the posterior wall of the cervix is divided and the vagina opened. Unless the

rectum is abnormally adherent, a condition that can easily be determined, there is no danger of injury to it. After the vagina has been opened, the incision can be extended around the cervix with little danger of injury to the bladder so long as the incision is kept close to the cervix, and the cervix removed.

After the uterus is removed and the vagina sponged dry, the bladder fold of the peritoneum is sutured to the anterior wall of the vagina, the fold of peritoneum from the culdesac of Douglas is sutured to the posterior wall of the vagina, and then the 2 layers of the broad ligament are brought together as described above under supravaginal hysterectomy, puckering down the broad ligament and the infundibulopelvic ligament to the upper angle of the vagina. If there is no need for drainage, then the anterior and posterior walls of the vagina are sutured together and the abdomen closed. If drainage is necessary, the top of the vagina should be closed only at the sides, leaving an opening smaller than the entire top of the vagina through which the gauze or tube drainage can pass. If too large an opening is left, there is danger of prolapse of the intestines through it when the gauze is removed.

MORTALITY

The following table gives the immediate operative results of the different operations for fibroma uteri performed in the gynecological service of the Roosevelt Hospital during a period of 11 years, between 1902 and 1913. No cases of mucous or fibrous polypi protruding through the cervix are included in the table.

OPERATION	1902-1908			1908-1913			1902-1913		
	NUM- BER	DEATHS	PER- CENTAGE	NUM- BER	DEATHS	PER- CENTAGE	NUM- BER	DEATHS	PER- CENTAGE
Supravaginal hysterectomy.....	164	8	5.	264	10	3.78	428	18	4.2
Complete abdominal hysterectomy.....	49	7	14.3	64	6	9.3	113	13	11.
Abdominal myomectomy.....	70	2	3.	121	2	1.6	191	48	2.
Vaginal hysterectomy....	28	1	3.4	3	0	0	31	1	3.
Vaginal myomectomy....	5	1	20.	4	0	0	9	1	11.
Total.....	316	19	6.	456	18	3.73	772	37	4.76

It will be noted that during the entire period of 11 years, between 1902 and 1913, there was a total of 772 cases with 37 deaths, a mortality of 4.76 per cent. During the period of 6 years between 1902 and 1908 there were 316 cases with 19 deaths, a mortality of 6 per cent., and during the period of 5 years between 1908 and 1913 there were 456 cases with 18 deaths, a mortality of 3.73 per cent., that is, during the last 5 years there was an improvement in the mortality rate of $1\frac{1}{4}$ per cent. over the previous 6 years. This improvement should be

ascribed to 2 causes, one the improvement in operative technic and the other a decrease in the extent and severity of the complications. The mortality percentages of all the cases fairly represent the average percentages of different operators for the periods, but not for the different kinds of operations. The 11 per cent. mortality for vaginal myomectomy is much too high for an average in this type of operation, and it is explained by there being 1 death, which was from a pulmonary embolism—a surgical accident and largely unavoidable—in a total of a small number of cases. A vaginal myomectomy would be done only in a very simple case, and the risk should be very slight.

Another point that must be remembered in studying the total mortality percentages is that a number of the patients at the time of operation had organic diseases making them bad surgical risks, or complications of a nature that the operative risk of the complication was greater than the risk of the removal of the fibroma itself. This explains the greater mortality following complete abdominal hysterectomies for fibromata uteri than supravaginal hysterectomies. It is not because the removal of the cervix is associated with a much greater risk, but on account of the condition present which necessitated its removal. With a patient without serious organic disease, the operative risk of the removal of an uncomplicated fibroid is small. This point will be shown by a study of the table following, which gives the most important complication of each case that died.

COMPLICATIONS OF CASES THAT DIED

Appendicitis.....	2
Cystic ovaries.....	3
Salpingo-oöphoritis.....	12
Ovarian cyst.....	1
Tuberculous peritonitis.....	1
Endocarditis.....	3
Profound secondary anemia.....	3
Diaphragmatic hernia.....	1
Carcinoma of rectum.....	1
Carcinoma of cervix uteri.....	1
Miscellaneous.....	9
Total.....	37

The following table gives the cause of death so far as could be determined:

CAUSE OF DEATH

Pulmonary embolism.....	5
Chronic nephritis.....	2
Pneumonia.....	1
Endocarditis.....	1
General peritonitis.....	3
Intestinal obstruction.....	4
Tetanus.....	1
Died on table.....	4
Miscellaneous.....	16
Total.....	37

The following table gives the percentages of the different types of operation for the time periods:

	1902 to 1908	1908 to 1913	1902 to 1913
Supravaginal hysterectomy.....	52 per cent.	58 per cent.	55 per cent.
Complete abdominal hysterectomy.	15 per cent.	14 per cent.	15 per cent.
Abdominal myomectomy.....	22 per cent.	26 per cent.	25 per cent.
Vaginal hysterectomy.....	9 per cent.	1 per cent.	4 per cent.
Vaginal myomectomy.....	2 per cent.	1 per cent.	1 per cent.
	100 per cent.	100 per cent.	100 per cent.

This table illustrates the average frequency with which the different operations are indicated. It also shows the tendency during the past 5 years to do more myomectomies and to do fewer vaginal operations. I personally favor both of these tendencies. By reference to the tables and comparing the 2 time periods, it will be seen that, while the percentage of cases in which a myomectomy was done has increased, the percentage of deaths is decidedly less. One of the 2 deaths occurring during the last 5 years was from tetanus and was probably the result of removing the appendix and not of the myomectomy. It is my opinion that myomectomy should be performed more frequently than it is, and that its risk is overrated.

There is no doubt that there are cases in which a vaginal operation has distinct advantages over an abdominal one and is indicated, but the tendency to do fewer vaginal operations has my strong approval. In years past the danger of opening the abdomen was such that surgeons avoided doing so when possible and vaginal operating was highly developed, but, as that danger has been greatly diminished, there is less demand for the vaginal route, and fewer vaginal hysterectomies or myomectomies are done.

THE COMPARATIVE END RESULTS OF MYOMECTOMY AND HYSTERECTOMY

Mortality.—The comparative mortality of myomectomy and hysterectomy cannot be determined by the mortality tables. In my own table, for example, the mortality from all abdominal myomectomies is less than 2 per cent. and the mortality for all abdominal hysterectomies is 5.8 per cent. These figures would indicate that a myomectomy is the safer operation of the 2, while, as a matter of fact, if we except the most simple cases, a myomectomy is the more extensive operation, and for the same class of cases the mortality is undoubtedly higher.

Recurrence.—There is practically no recurrence after an hysterectomy for fibroma uteri. Winter, excluding submucous tumors, reported 8 per cent.

recurrences following myomectomy for fibroma uteri. These cases, however, were previous to 10 years ago, and the percentage of recurrences higher than those in more recent work. Mackenrodt, in 1913, reported 167 cases of myomectomy with 5 cases or 3 per cent. of recurrences, and of these 5 cases only 1 required subsequent operation. The figures of Mackenrodt more correctly indicate the recurrences following myomectomies at the present time.

Cure of Symptoms.—If we exclude possible nervous and mental symptoms caused by the abnormal cessation of menstruation, most women would be in better physical condition if the uterus, tubes and ovaries were removed. A comparative study of cases that have had a myomectomy and cases that have had an hysterectomy performed for fibromata of the uterus confirms this statement, and there is no doubt that a larger percentage of cases are relieved of all symptoms by an hysterectomy than by a myomectomy. The older the patient, the less is the risk of nervous disturbances resulting from the removal of the ovaries and the cessation of the menstruation, also the less chance of pregnancy and often the greater need of the best general health possible, so that the age of the patient is an important factor in deciding between a myomectomy and an hysterectomy.

Pregnancy Following Myomectomy.—The further the fibroma is from the mucous membrane, the greater the chance of pregnancy subsequent to a myomectomy. A subperitoneal pedunculated fibroma has little or no effect in producing sterility, and its removal does not interfere with subsequent pregnancy. The reason for this is, doubtless, the influence on the mucous membrane. With a subperitoneal fibroid, the mucous membrane of the uterus is slightly affected, but with a fibroma more deeply seated in the uterine wall, there is a greater influence on the mucous membrane and it is often so changed that a pregnancy does not occur. From this it follows that appropriate treatment of the endometrium should be included with a myomectomy. Winter states that pregnancy rarely follows a myomectomy if the tumor removed is larger than a child's head and rarely occurs in patients over 40 years of age. Cullen, excluding patients who, on account of age, civil condition, etc., were unlikely to become pregnant, reports 13 patients out of 94 cases of abdominal myomectomy who become pregnant; of these 13 cases, 12 went to term and 1 miscarried. Judging from statistics of various writers, probably about 10 per cent. of possible cases become pregnant after abdominal myomectomy. It is not easy to estimate the percentage of pregnancies following vaginal myomectomy because some writers include the removal of fibrous polyps as myomectomies and others do not. If these cases are not included, the percentage of pregnancies must be less, as there would be greater change in the endometrium and this is the determining factor.

CHAPTER XIII

CARCINOMA OF THE UTERUS

HOWARD C. TAYLOR

DEVELOPMENT OF OPERATION FOR CARCINOMA UTERI

There has been an interesting series of advances in the development of the present operation for carcinoma of the cervix uteri. Each step has been looked upon as a radical procedure and has often been associated with a considerable increase in mortality.

The first operations were the removal or destruction of the carcinomatous growth with the actual cautery. It is an interesting fact that, while the destruction of the growth with the cautery was the first operation for carcinoma of the cervix uteri, it is still a procedure that is advocated, in a certain class of cases, by some men, and also the results of which as reported more than 20 years ago by Dr. John Byrne of Brooklyn, compare favorably with the results obtained in America by the more modern and extensive operations. While it is true that many of his cases had no pathological report to confirm the diagnosis, yet, with a man of Dr. Byrne's experience, the diagnosis was probably not frequently wrong.

In 1783, by Marschall, the first recorded case where cutting was done was performed. He removed a carcinomatous cervix from a woman with a prolapse of the uterus. This was followed in 1801 by Osiander, who removed a carcinomatous growth from a uterus in its normal position. While the operation here was comparatively the same as Marschall's first operation, it was a much more difficult one on account of the position of the uterus. With the uterus prolapsed and the cervix outside of the vagina, to remove the cervix without injuring the bladder or rectum, or having unusual hemorrhage, was a comparatively simple matter. Following the publication of Osiander's operation, it was performed by a number of other operators, but with considerable mortality, either from hemorrhage or from general sepsis.

The next advance in operative treatment of carcinoma of the cervix uteri was vaginal hysterectomy, the first of which was probably performed by Langenbeck in the year 1813. This, like the first amputation of the cervix,

was on a woman with a prolapse of the uterus. This operation would be looked upon to-day as a relatively easy one, but it was not easy for Langenbeck and he probably did not thoroughly understand the anatomy of a prolapse of the uterus, as he states, in the description of the operation, that he removed the uterus together with the ovary, but that he did not injure or open the peritoneal cavity.

The next step was the removal of a uterus normally situated, through the vagina, which was done in the year 1821 by Sauter. This operation was done very crudely, apparently with a small knowledge of the exact anatomy of the uterus and with little serious attempt to control all the bleeding, due to the undeveloped condition of the surgery of the day. It is not surprising, therefore, that here again this new step was associated with a high mortality, and many men advised against its performance.

The next step forward was made by Freund, who in 1878 removed a uterus with a carcinomatous cervix through the abdomen. It is rather interesting that his fear in doing this operation was on account of the opening into the vagina, and in order to close this hole, the tube and ovary were used to take the place of the uterus. This operation was associated with the highest mortality of any operation regularly done for carcinoma of the cervix uteri, reaching at first as high as 70 per cent.

On account of the high mortality following the abdominal operation for carcinoma of the uterus the tendency was again toward vaginal hysterectomy. As operative technic improved and our knowledge of the cause of infection and of the use of vaginal drainage increased, the mortality from the abdominal operation gradually decreased.

The objection to all the operations that had been devised for the treatment of carcinoma of the uterus was that the number of actual cures, whether from the vaginal or abdominal hysterectomy, remained small.

This led a number of operators to devise an operation that would be more radical, that would get further away from the diseased tissue, and in this way permanently cure a larger number of patients. Clark, Rumpf, and Ries, all working independently and at about the same time (1895-1896), devised methods for removing the uterus together with a larger amount of parametritic tissue, and from their ideas has grown the radical abdominal hysterectomy for carcinoma of the uterus as it is done today. Here again a very high primary mortality was associated with this new operation, and again operators, especially Schauta, turned to vaginal hysterectomy as an operation that could, in their minds, be developed to as radical a procedure as an abdominal hysterectomy, and as one to be preferred as causing a smaller mortality.

We have then today for an operable case of carcinoma of the cervix uteri 4 possible operations, each one to be used under certain definite indications. The choice would be probably in the following order:

First: The radical abdominal hysterectomy.

Second: The simple abdominal hysterectomy.

Third: The radical vaginal hysterectomy.

Fourth: The simple vaginal hysterectomy.

Either a radical abdominal hysterectomy, or a radical vaginal hysterectomy, for carcinoma of the cervix uteri, is an operation of great magnitude, of great difficulty, and one associated with a very considerable mortality even in the hands of men who have had considerable experience with the operation.

Neither of these operations, therefore, should be performed on a woman who is in bad condition from any organic disease or who is a bad surgical risk from any cause. In such a case it would be better to select either a simple abdominal hysterectomy or a simple vaginal hysterectomy.

Speaking in general, the woman with a thin abdominal wall, particularly if she is a woman who has had no children and has, therefore, a firm perineum, is selected for an abdominal hysterectomy rather than a vaginal hysterectomy. On the other hand, a woman with a thick abdominal wall, increasing in that way the difficulty of the deep pelvic work through the abdomen, particularly if she has a relaxed vaginal outlet or any degree of prolapse of the uterus, is a case to be selected for a vaginal operation rather than an abdominal hysterectomy. The borderline cases will be determined by the preference of the surgeon for abdominal or vaginal operations.

INDICATIONS FOR OPERATION

As an operation is the only cure for carcinoma of the fundus or cervix uteri, and without it a fatal termination is sure, every patient should have an operation unless definitely contra-indicated. There are cases which are easily determined to be operable and there are cases easily determined to be inoperable. There are also cases where the decision is more difficult. When there is a doubt, the patient should be examined under an anesthetic and when necessary given the benefit of an exploratory laparotomy. It is only after the abdomen has been opened and the lymphatic glands and the parametrium examined by direct palpation that the operability of some cases can be determined. Wertheim considers every operation for carcinoma of the cervix uteri as an exploratory operation, and that the operability is only to be determined after the abdomen has been opened.

In addition to the general health of the patient the condition of the following organs and structures should be considered in deciding whether or not a case of carcinoma of the uterus is operable.

1. Uterus.
2. Vaginal walls.
3. Bladder.
4. Rectum.

5. Parametrium.

6. Lymphatic glands.

1. **Uterus.**—If the growth is limited to the uterus, the case is operable and more favorable than many cases that come to operation. This is true whether the tumor has taken the form of an extensive cauliflower growth or a deep ulceration.

2. **Vaginal Walls.**—When the growth has extended onto the vaginal walls, the outlook is less favorable, but the case is still operable if the deeper structures are not involved. An extension into the **posterior** vaginal wall is more favorable than one into the **anterior** vaginal wall, because the upper part of the **posterior** vaginal wall is covered with peritoneum and is not directly adherent to any organ, while the **anterior** vaginal wall is adherent either to the anterior surface of the uterus or to the base of the bladder. An extension into the vaginal walls at the sides is usually associated with involvement of the parametrium and it is a less favorable location for the extension than the posterior vaginal wall, but more favorable than on the anterior vaginal wall. It is possible to remove the involved parametrium if not too extensive and still get beyond the disease.

3. **Bladder.**—If the growth has extended into the anterior vaginal wall, the bladder is usually involved, and a cystoscopic examination of the bladder should be made to determine if the growth has extended to it.

If the cystoscopic examination shows that the bladder is involved, then the case should be considered as inoperable, because a resection of the bladder greatly increases the risk of the operation and the chances of either a cure or a prolongation of life are small.

If the bladder does not seem to be involved, the case should be considered operable, though there is considerable risk that the bladder may be injured or a resection of it necessary with the risk which attaches thereto.

4. **Rectum.**—The rectum is not attached directly to the uterus, and an involvement of it is usually found only in a late stage of the disease. The rectum, however, as a result of inflammatory action or of a displacement of the uterus, may become adherent to it and as a result the growth may extend directly to the bowel. A rectal examination, even though the rectum itself is not involved, will often furnish useful information. The uterosacral ligaments can be palpated from their attachments to the uterus to the attachments to the sacrum, and their condition determined. Enlarged sacral glands can often be felt.

If the wall of the rectum is involved, the case is beyond question inoperable. If the sacral glands are involved, the case is hopeless and no operation other than a palliative one should be done. If the uterosacral ligaments are involved only close to the uterus, and the case is otherwise considered operable, it is still possible to get beyond the growth, though the outlook cannot be considered favorable.

5. **Parametrium.**—The condition of the parametrium determines the operability of a case of carcinoma of the cervix uteri more often than any other factor.

Previous to the introduction of the radical or "extended" operation, any involvement of the parametrium was sufficient to place the case in the inoperable class; but, since then, a moderate involvement of the parametrium has not been considered a contra-indication to operation, though it greatly decreases the chances of a cure. The extent to which the parametrium can be involved, and the case still be considered operable, will vary with the skill and experience of each surgeon.

Clark's statement, that a case is considered operable when the "interstitial or ulcerative growth extends not more than one inch into the broad ligament, well defined as a wedge-like mass, with the remainder of the broad ligaments soft and pliable" is conservative but sound.

Care must be taken not to mistake inflammatory induration for malignant involvement. Inflammatory disease of the appendages, or pelvic cellulitis resulting from the infected and broken down growth in the cervix, may fix the uterus, though the tumor is limited to the uterus itself.

6. **Lymph Glands.**—The lymphatic vessels from the fundus uteri run chiefly to the lumbar lymph-nodes. A few vessels follow the round ligaments to the inguinal nodes and a few also to the iliac nodes. From the cervix uteri and upper part of the vagina, the lymphatic vessels pass frequently to a single node placed at the crossing of the ureter and the uterine artery and then to the iliac nodes. Another stream passes by way of the uterosacral ligaments to the sacral nodes. The lymphatic nodes in carcinoma of either the fundus or cervix uteri are involved late in the disease, and if they are found, either by rectal examination or by an exploratory laparotomy, to be diseased, the case is probably hopeless as to a permanent cure, and probably inoperable, but not of necessity absolutely so. **Enlarged nodes are not necessarily carcinomatous.** They may be enlarged from inflammatory action, or even, as in one case of my own, from tuberculous infection. A single node or a short chain of nodes may be removed and occasionally the case permanently cured, according to the test of 5 years' freedom from recurrence. If the nodes are diseased, more especially if that fact has been determined by an exploratory laparotomy, a simple hysterectomy may be indicated as a palliative measure. The additional risk, duration of convalescence and operative discomfort are more than overbalanced by the removal of the sloughing, infected malignant growth. The condition of the nodes, therefore, should be considered only as a factor in deciding the operability of a case and not as an absolute criterion.

PREPARATION OF PATIENT FOR OPERATION

The most frequent cause of primary mortality following operation for carcinoma of the uterus is infection. This infection is usually from the broken-

down malignant growth of the cervix, and to minimize this danger it is necessary to sterilize as far as possible the vagina and this infectious focus. To make an incision into any malignant tissue in the body is associated with the risk of the cancer cells being scattered into the tissues previously free of any malignant element. As usually seen, a carcinoma of the cervix is broken down and infectious, and cutting into it with a knife or curet is associated not only with a risk of scattering the carcinoma cells into the parametritic tissues, but also with the danger of allowing pyogenic germs access into these tissues and into the peritoneum. There is, on the one hand, danger of infection if the growth is not very largely removed or sterilized, and, on the other hand, the danger of infecting the field of operation with pyogenic germs or with cancer cells if the growth is removed with a knife or curet. The best method, therefore, when it is possible to do so, is to sterilize the growth with the cautery. The ordinary Paquelin cautery is not heavy enough for this work, as much time is lost in waiting for the point to heat after it has been inserted into the tissue. An extra heavy electric cautery or cautery irons are, therefore, much to be preferred. If the growth is of moderate extent and limited to the cervix, it is possible to remove it with the cautery knife without the danger of infecting the surrounding tissue, because the cautery seals the blood and lymph channels as it destroys the growth. In the more extensive cases, it is not possible to cut away the growth with the cautery, and it is necessary, therefore, to destroy it as far as possible by actual burning. In some cases it is not possible to destroy as much growth with the cautery as could be removed with the curet, and under such circumstances it is probably better to remove more of the tissue with the curet, even at the risk of introducing cancer cells into the parametritic tissues, than to run the risk of pyogenic infection by insufficient sterilization. It is best to spend considerable time, if necessary, in thorough cauterization of the growth before proceeding with the operation, as this, beyond question, materially diminishes the risk of peritoneal and parametritic infection. After the growth has been cauterized, the vagina should be thoroughly washed, dried and painted with tincture of iodine. During the manipulations of the uterus, in its removal, there may be some discharges, or bleeding from the uterus. The cavity left after the cauterization of the growth and the vagina should, therefore, be packed with sterile gauze, to absorb these discharges. This gauze should be removed and the vagina again sponged dry from below before it is opened from above.

The special method of treating the cervix in the radical vaginal operation for carcinoma of the cervix uteri is included in the description of that operation.

OPERATIVE TECHNIC

Radical Abdominal Hysterectomy for Carcinoma of the Cervix Uteri.—A median incision extending from the umbilicus to the symphysis is the best in-

cision for most cases. Franz and some other European operators use the transverse incision of Pfannenstiel, with specially devised self-retaining retractors for holding the wound open. Mackenrodt advised a transverse incision from one iliac spine to the other through all layers of the abdominal wall, in order to give a wide exposure at the sides of the pelvis. While this exposure is an extensive one, the intestines are apt to get in the way and the abdominal wall is subsequently very much weakened by such an incision. If necessary to secure greater relaxation, the division of the recti muscles, at their insertion

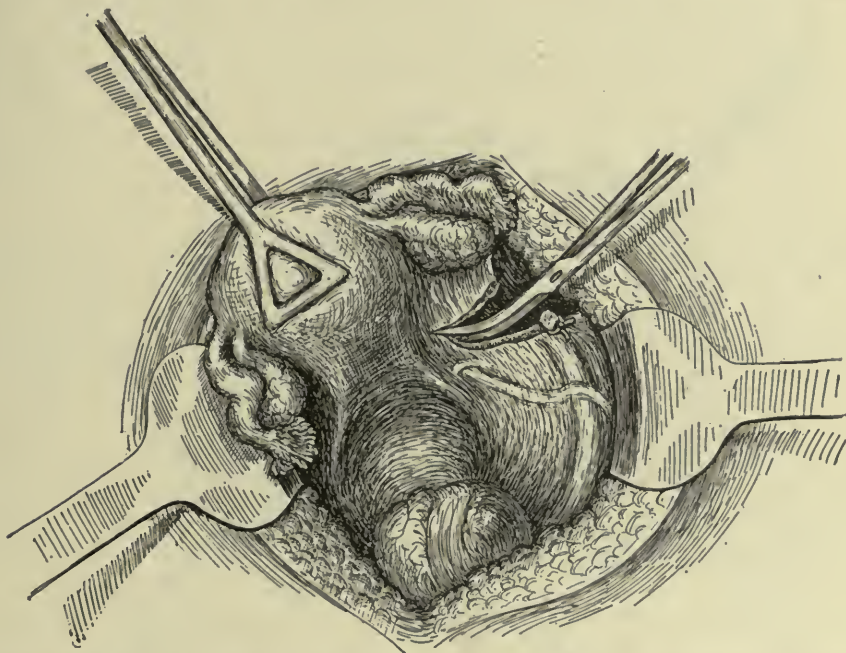


FIG. 1.—ABDOMINAL HYSTERECTOMY FOR CARCINOMA CERVIX UTERI. Ligation of Infundibulopelvic Ligament; Incision of broad Ligament.

into the symphysis pubis, is less mutilating and will give the desired exposure. Whatever incision is used, it should be protected to prevent contact with carcinomatous tissue to avoid infection of the wound with either cancer cells or pyogenic organisms. The patient is placed in the Trendelenburg position and the intestines are pushed up out of the pelvis and covered with numerous abdominal pads.

The uterus is seized with a double volsellum forceps and drawn forward to one side. Care must be taken in using traction upon the uterus, particularly in the early part of the operation before the blood-vessels are tied off, so that none of the cancer cells will be forced out into the tissues by these manipulations. The tubes and ovaries are separated from any adhesions that may be present. The uterus is drawn gently to one side, the infundibulopelvic ligament containing the ovarian vessels is exposed and ligated close to the pelvic wall,

and the ligature cut short. The round ligament on that side is exposed and ligated about 2 in. away from the horn of the uterus. It is a mistake to ligate the round ligament too far out, as this is not a place where a recurrence is likely to occur, and if the ligament is ligated too near the pelvic wall so much of the peritoneum will be removed that there will not be enough to cover the wound area at the end of the operation. It is important that there should be sufficient peritoneum left to cover the wound area, as the peritoneal cavity should be

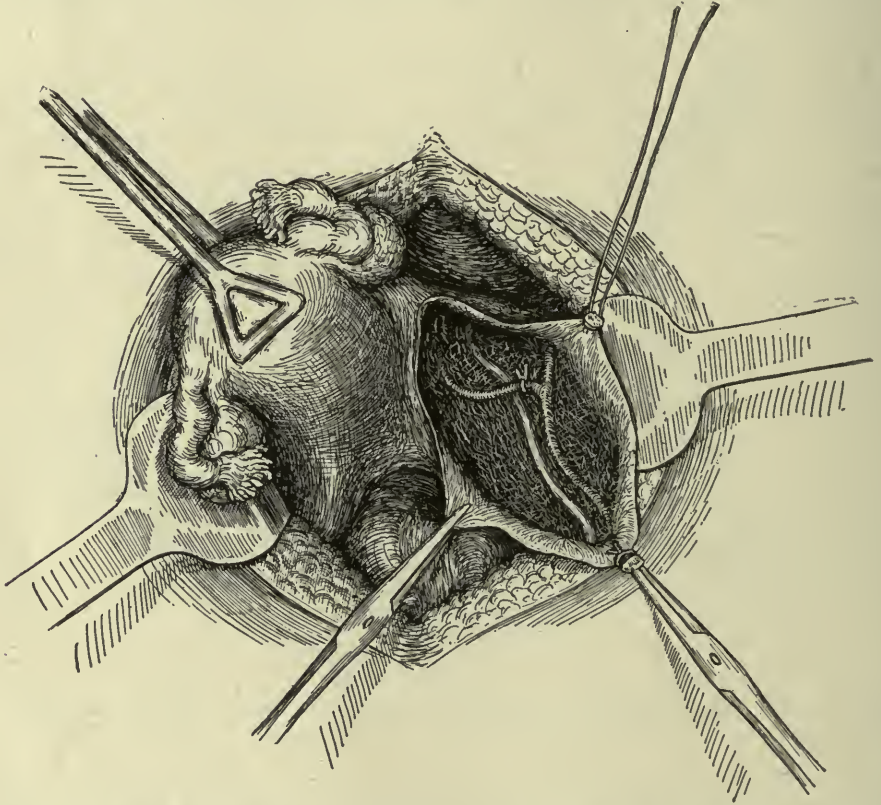


FIG. 2.—COMPLETE HYSTERECTOMY FOR CARCINOMA CERVIX UTERI. Exposure of Ureter and Uterine Artery.

entirely closed off from the vagina at the end of the operation to diminish the chance of infection and to hasten healing. The ligature used for ligating the round ligament should be left long and used to hold the layers of the broad ligament apart to assist in the exposure of the ureters. A clamp is now put on the broad ligament at its juncture with the uterus, including the tube and utero-ovarian and round ligaments, to prevent any reflux bleeding after the ligaments have been divided. This clamp may be used to assist in the traction on the uterus if necessary. The infundibulopelvic and round ligaments are divided close to the ligatures, and the broad ligament separated into its anterior and posterior layers. The anterior layer is cut inward as far as the uterus near a

point where the bladder is reflected from the uterus. The posterior layer is divided downward and inward toward the uterosacral ligament.

The uterus is next drawn to the opposite side and the procedure already described is carried out on the other side. The incision through the anterior fold of the broad ligament is carried across in front of the uterus, along the line where the bladder is reflected from it, to join the similar incision from the opposite side. Each ureter should next be exposed.

There are 3 places at any one of which the ureter can be found. The operator should be familiar with each of these places and if the ureter is not easily located in 1 place it should be searched for in one of the other 2. The first place is either directly under the peritoneum as it crosses the iliac vessel, or in the posterior layer of the broad ligament. The second place is in the front, just as the ureter enters the bladder, and the third is at the side of the uterus where it is crossed by the uterine artery.

I usually find the ureter under the peritoneum forming the posterior layer of the broad ligament. As the infundibulopelvic ligament is divided, the incision in the posterior fold of the broad ligament is carried inward and backward toward the uterosacral ligament. The incision will ordinarily cross the ureter directly under the peritoneum after it has crossed the iliac vessel. Care should be taken, however, in making this incision that the ureter is not divided, as it is located directly under the peritoneum.

If the ureter is not found readily here, then an attempt should be made to find it as it enters the bladder. The bladder is pushed down (better by dissection with the scissors than by pushing with a sponge) until it is free from the uterus down to the vagina. By working out first to one side, then to the other, the ureters will be located as they enter the bladder. If the ureter is not found in either of these places, it can be found at the side of the uterus by following out the uterine artery. The ureter will be located at the point where it is crossed by this artery.

It is not necessary nor wise in my opinion to insert catheters into the ureters to facilitate finding them, as has been advised. To locate the ureters is not the difficult part of the operation, and their mucous membranes are easily injured if catheters are inserted before the operation.

The incision in the posterior layer of the broad ligament is next carried across the culdesac of Douglas, joining the incision in the posterior layer of the broad ligament on the opposite side. This incision should be below the uterus on the posterior vaginal wall. The peritoneum is now divided from one infundibulopelvic ligament across to the other, both in front of and behind the uterus. It is necessary to separate the rectum from the posterior vaginal wall, as it is desirable to remove the upper part of the vagina. Each uterine artery is located at the side of the uterus where it crosses the ureter and is ligated outside of the ureter. In some cases it may be desirable to control the bleeding still more surely by ligating the anterior division of the internal iliac artery at the point where it is given off from the main trunk.

The next step is the division of the pelvic connective tissue as far away from the uterus as possible. There are 3 places on each side where it is possible to remove the greatest amount of connective tissue. They are (1) behind at the uterosacral ligament, (2) at the side at the base of the broad ligament, and (3) in front and below at the side of the upper part of the vagina. It is best that clamps should be used, as they can be placed more easily than ligatures and the tissue cut close to the clamp before ligating. If the connective tissue is divided before it is clamped or ligated well away from the uterus, it is apt to contract against the pelvic wall and deceive the surgeon as to the real amount of connective tissue that is being removed and there may also be troublesome bleeding. Any curved clamp that is not too short is suitable for this use. The clamps devised by Wertheim are unnecessarily heavy for this purpose and are clumsy and in the way.

The first tissue to be divided, if it is accessible, is the uterosacral ligament, first on one side and then on the other. The uterus is drawn forward, the peritoneum and rectum having been pushed from the vagina, and a clamp is put on each uterosacral ligament as far away from the uterus as possible without injury to the rectum. The ureter is close to the outside of the uterosacral ligament, and care must be taken not to include it in the clamp nor to divide it with the scissors. This tissue is then divided close to the clamp, between it and the uterus. The clamp can be left for the time being, or, preferably, if it can be easily done, the tissue it contains is ligated at once and the clamp removed. The uterosacral ligaments hold the uterus in the pelvis and when they are divided the uterus comes up more readily into the wound.

The next step is the separation of the cellular tissue at the side of the uterus by following along the ureters to the bladder and working out as far toward the pelvic wall as possible. This tissue is clamped close to the pelvic wall with 1 or 2 curved clamps and the tissue divided close to the clamp.

It is very important that clamps are used and that the tissue is not divided until it has been clamped or ligated, otherwise there may be troublesome or even fatal hemorrhage. This is the most important, the most difficult, and often the most serious part of the operation.

This cellular tissue is close to the malignant growth, the lymphatic vessels from it to the iliac nodes pass through it, and its wide removal has much to do with the ultimate result of the operation. To the outside near the pelvic wall, and in front at the side of the bladder, there may be venous bleeding, which is hard to control. Probably more patients have been lost from fatal hemorrhage at this point than from any other cause during the operation. All tissue should invariably be clamped or ligated before it is divided to avoid this result. Every bleeding point should be clamped and ligated at once. Clamps left on are in the way and obscure the operative field. If much bleeding starts, the field is obscured by blood before the sponge is out of the wound and the vessel is caught blindly and with possible fatal injury. The uterus

is now free except as attached to the vagina and to the connective tissue at the side of the vagina. The bladder is separated from the vagina further down, preferably with the scissors rather than with the sponge. The vagina has been separated from the rectum behind.

At this point, in order to decrease the chance of infection when the vagina is opened, the gauze that has been left in the vagina should be removed and the vagina should be sponged dry and swabbed out with tincture of iodine.

The opening of the vagina is an important step in the operation because faulty technic increases the risk of infection, which is the most frequent cause

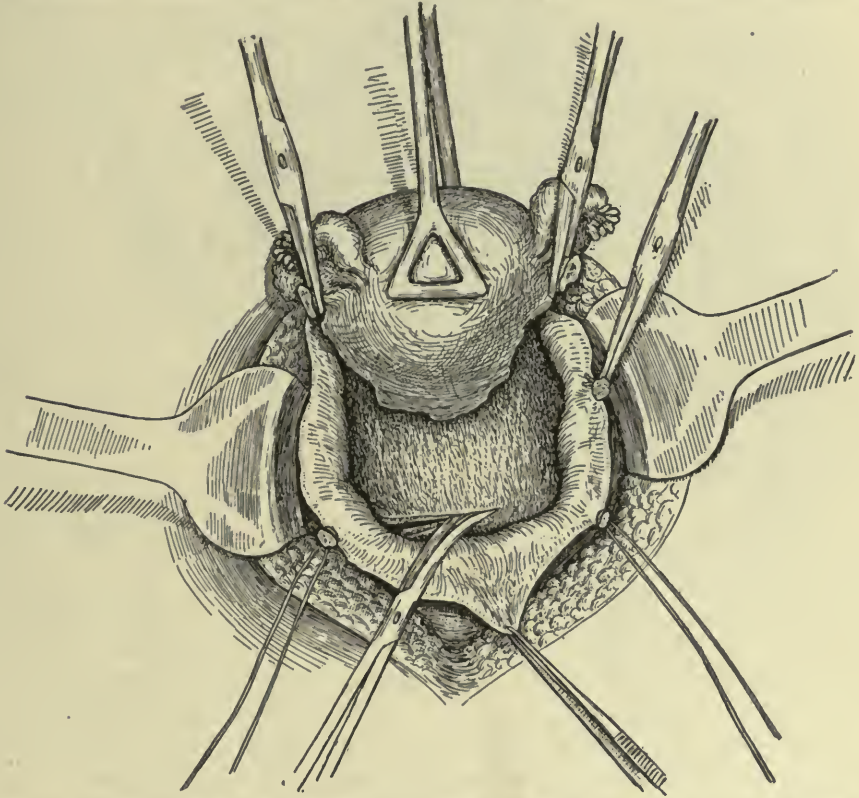


FIG. 3.—COMPLETE HYSTERECTOMY FOR CARCINOMA CERVIX UTERI. Opening of Vagina.

of prolonged convalescence and of primary mortality following the operation. The safest plan is to clamp the vagina below the growth either with Sigwart's clamp or with Wertheim's right-angle clamp before opening the vagina. This procedure shuts the infectious growth in the upper part of the vagina and allows none of the discharges to come in contact with fresh wounds. This, however, in my experience is not always possible. The vagina may have been opened accidentally during the separation of the bladder or by the manipulation of the uterus itself. In some cases it is difficult to get

the necessary room to apply the clamps. Many operators use the Wertheim right-angle clamps for closing off the vagina, but personally I prefer that of Sigwart.

The following technic should be followed: The vagina is clamped as far below the growth as possible, without injury to the bladder or rectum, with a Sigwart clamp. This clamp includes the vagina but does not include the connective tissue at the sides. The anterior vaginal wall is opened with a knife or scissors below the Sigwart clamp. The vagina is again sponged dry

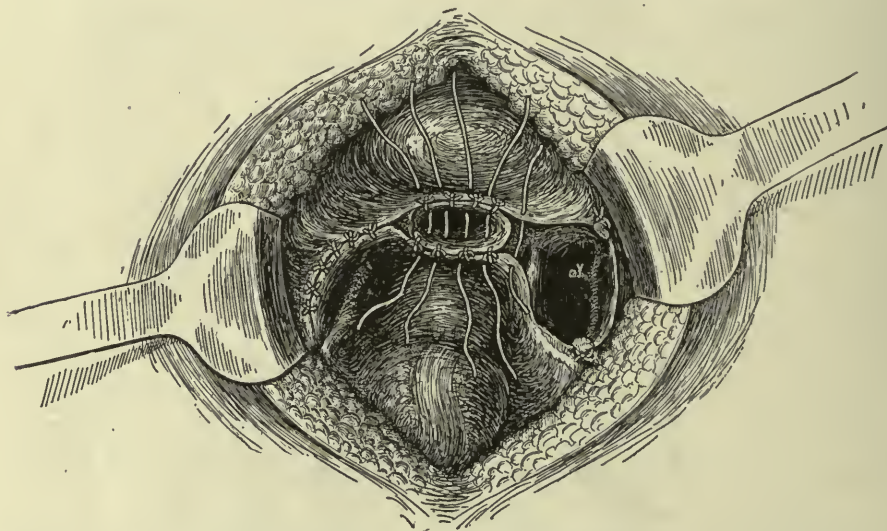


FIG. 4.—COMPLETE HYSTERECTOMY FOR CARCINOMA CERVIX UTERI. Closure of Vagina.

through the opening and painted with tincture of iodine. The remainder of the vagina is divided below the clamp and the uterus and upper part of the vagina are now free except for the band of connective tissue at each side of the vagina. This is the third place where the connective tissue can be removed well away from the malignant growth. This connective tissue is clamped well away from the uterus, care being taken again to avoid the ureters, and divided close to the clamp. The uterus and the upper part of the vagina are now entirely free. Any enlarged glands along the iliac vessels should next be removed.

We have now a large wound area in the pelvis and it is necessary to cover this completely with the peritoneum, instituting such drainage as may be necessary in case of any infection or in case of necrosis of the ureters. Some men in certain early cases close the vagina entirely without drainage, but this is rarely advisable. If the original growth was a small one and it has been entirely removed with the cautery, there is, of course, very little danger from infection. There is, however, always a certain risk of necrosis of the ureters, and a little drainage to lessen the danger from infection, in case there is necrosis, does not do any harm.

The bladder fold of peritoneum in front is sutured to the anterior vaginal

wall, the peritoneal fold from the rectum behind is sutured to the posterior vaginal wall, excepting for a distance of about 2 cm. at each side of the vagina. The anterior and posterior layers of the broad ligament are next sutured together, beginning at the infundibulopelvic ligament and extending down as far as the vagina. A small piece of gauze is inserted beneath the broad ligament on each side of the vagina where the peritoneum has not been sutured to it. The anterior and posterior walls of the vagina are next sutured together, except at the sides where the gauze leads under each broad ligament. Any places in the broad ligament where the 2 layers of the peritoneum have not come together smoothly should be reinforced by interrupted catgut sutures. We have then, at the end, the general peritoneal cavity entirely closed off from the vagina and from the field of operation. There is a small piece of gauze under each broad ligament, leading into the vagina at each lateral angle of the top. It is necessary in placing this gauze to be sure that it does not come in contact with the ureter, otherwise it may become adherent to it and when it is withdrawn it may tear the ureter. The gauze should be small in quantity and is merely to keep the upper lateral angles open into the broad ligament to allow any drainage that may be necessary. In closing the abdominal wound, non-absorbent suture material should be used in part, as many cases of carcinoma of the uterus are in a weakened condition, with recuperative powers poor and healing slow. If only absorbable catgut is used it may be absorbed before the wound is healed, leading possibly to an opening of the wound and protrusion of the intestines.

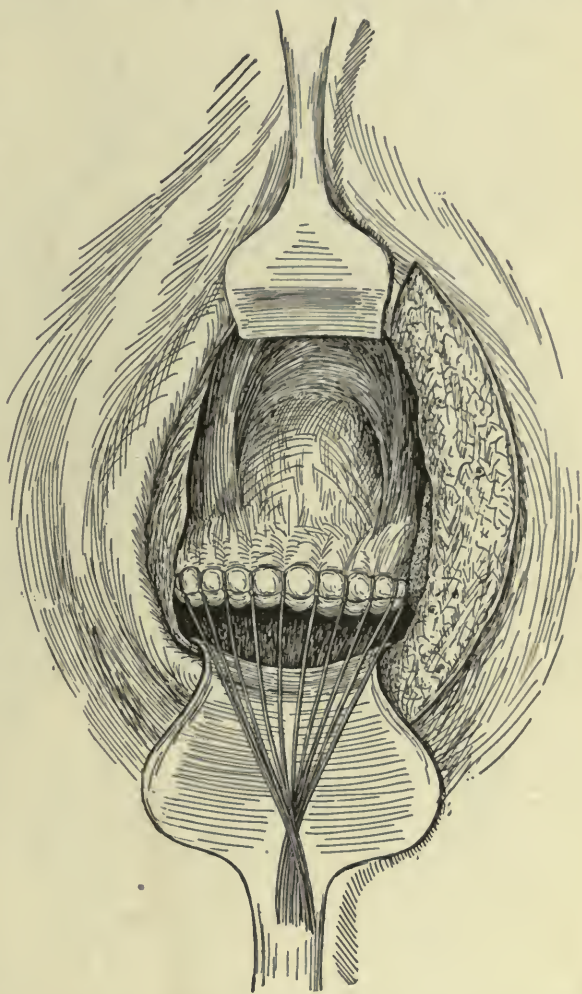


FIG. 5.—RADICAL VAGINAL HYSTERECTOMY FOR CARCINOMA CERVIX UTERI. Schuchardt paravaginal incision; vaginal wall sutured over cervix.

Radical Vaginal Hysterectomy.—The radical or “extended” vaginal operation for carcinoma of the cervix uteri is the result of an attempt to obtain, with a smaller primary mortality, as favorable results at the end of the 5-year period as are obtained by the radical abdominal operation.

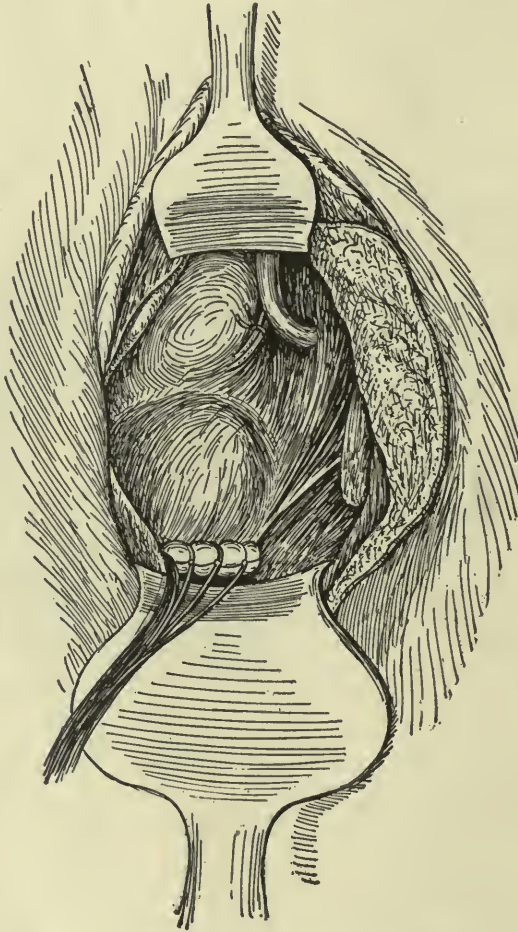


FIG. 6.—RADICAL VAGINAL HYSTERECTOMY FOR CARCINOMA CERVIX. Exposure of ureter.

Schuchardt in 1893 devised the “Schuchardt paravaginal incision,” and it is by the use of this incision or some modification of it that the radical removal of a carcinoma uteri through the vagina is rendered possible. This incision extends from the vicinity of the cervix down the lateral or posterior wall of the vagina to near the middle of the left labium. From this point it is continued through the skin as a curved incision with the convexity outward as far as the side of the anus but not near enough to it to injure the external sphincter muscle. The incision opens out the vagina and renders the uterus and the parametrium accessible in a way that is not possible without it.

I have myself never performed this operation nor have I seen it performed in America. It is certainly performed only rarely if at all here. In Germany and Austria, though I have seen the radical abdominal operation in a number of different clinics, I have only seen the radical vaginal operation done in Schauta's clinic in Vienna. The literature, however, contains reports of series of cases by other operators and the operation is undoubtedly done elsewhere, but not to the same extent that the radical abdominal operation is performed. As the operation is performed in the Schauta clinic, the amount of parametritic tissue that is removed compares favorably with the amount that is removed by the abdominal operation. There is, of course, no attempt to remove the iliac lymph-nodes. The operation is particularly difficult and should be limited to cases which are bad surgical risks, since a vaginal operation in general is associated with less shock than an abdominal operation. The description of the operation is practically that which is followed in Schauta's clinic.

To sterilize the field of operation the cervix is removed as thoroughly as possible, preferably with the cautery. If the curet has to be used the crater should be cauterized to complete its sterilization. A circular incision is made around the vagina at the junction of its upper and middle thirds or even lower. The upper part of the vagina is dissected free and is turned down as a cuff over the cervix, and the edges of this cuff are sutured together, inclosing the cancerous cervix. The effect of this is to shut in the infectious area entirely and to protect the wound from pyogenic germs and from the implantation of cancer cells. The ends of the sutures are left long for tractors. Fresh instruments and gloves are used for the remainder of the operation.

The separation of the anterior vaginal wall from the bladder is continued

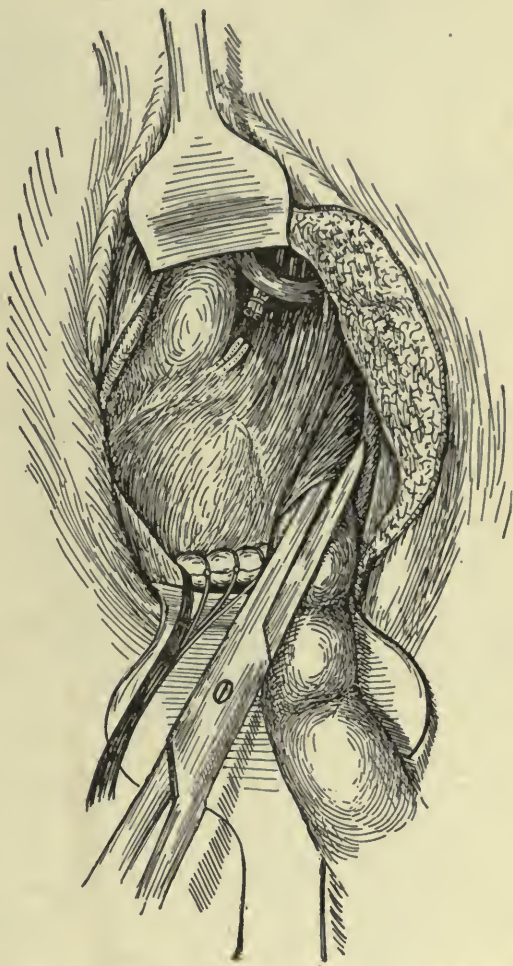


FIG. 7.—RADICAL VAGINAL HYSTERECTOMY FOR CARCINOMA CERVIX UTERI. Division of parametrium.

to the point where the bladder is reflected on to the uterus and then the bladder, partly by blunt dissection and partly with the scissors, is separated from the uterus. At this point it is determined whether or not the case is one suitable for a radical operation.

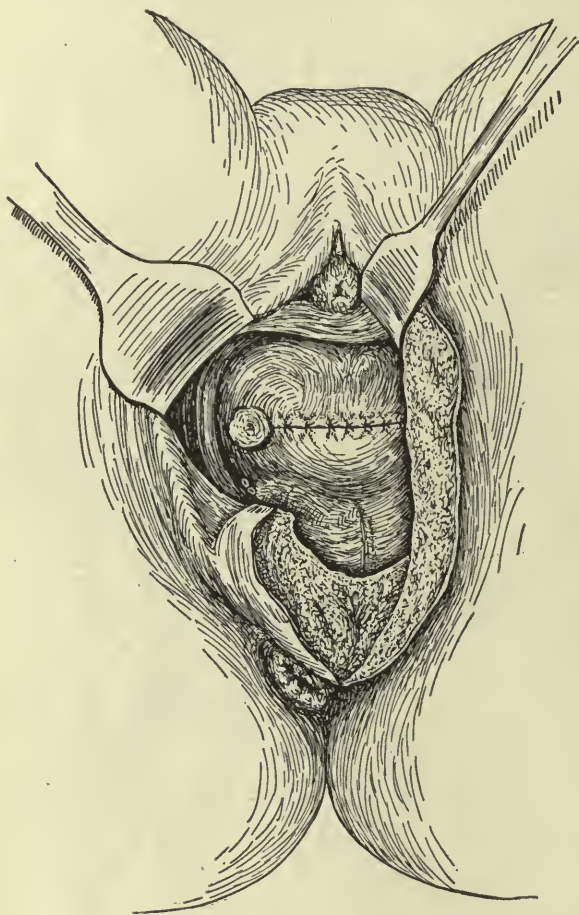


FIG. 8.—RADICAL VAGINAL HYSTERECTOMY FOR CARCINOMA CERVIX. Closure of peritoneum.

If it is too far advanced, the wounds can be closed and no extensive incisions have been made. If it is decided that the case is operable, the Schuchardt paravaginal incision is made, and the field of operation rendered more accessible. The bladder is separated more at the side and the ureter is generally exposed opposite the internal os, where it is crossed by the uterine vessels, and then the uterine vessels are ligated. Douglas' culdesac is now opened, and a finger inserted to control the division of the parametrium, close to the pelvic wall. As the uterine vessels have been ligated, the bleeding is slight and the tissue is divided without first ligating it in order to get nearer to the pelvic wall. The round ligament, the fallopian tube and the utero-ovarian ligaments on each side are ligated either with the uterus in situ or after it

has been turned into the vagina, and the uterus is removed. The ovaries and tubes are ordinarily not removed. The peritoneum is sutured, to close off the abdominal cavity, the ligaments are drawn to the vagina so that they are extra-peritoneal, and the wound is drained with gauze. The Schuchardt incision is sutured and the operation completed.

Simple Abdominal Operation.—This operation is much less extensive than the radical or extended abdominal hysterectomy, it can be done in a shorter time and is associated with less risk.

It is, therefore, the operation to be selected in preference to the radical abdominal hysterectomy, if the patient is a bad surgical risk from any cause.

A thick abdominal wall from the deposit of fat greatly increases the difficulty of any abdominal operation and a simple abdominal hysterectomy or a radical vaginal hysterectomy should be selected in fat women. While the risk of infection is not as great in the simple abdominal hysterectomy as in the radical operation because the intraperitoneal wounds are less extensive, there is definite danger of infection with pyogenic bacteria and of implantation of cancer cells. Before opening the abdomen, therefore, the malignant growth should be sterilized as nearly as possible, as described in the technic of the radical abdominal operation.

A median incision from the symphysis pubis nearly to the umbilicus should be used, as it is more quickly made and gives a better exposure than the transverse incision. The abdominal wound should be protected to avoid infection. The uterus is seized with heavy volsellum forceps and drawn gently to one side. Care should be taken to use no unnecessary force, or cancer cells may be forced into the tissues leading to an early recurrence of the growth.

The infundibulopelvic ligament outside the tube and ovary and then the round ligament, 2 cm. from the uterus, are ligated, first on one side and then on the other. No attempt should be made to retain either ovary or tube. Clamps are placed on each side to control the reflux bleeding, and the ligated ligaments with the intervening broad ligaments are divided to the side of the uterus. An incision through the peritoneum is made across the front of the uterus at the line where the peritoneum is reflected from the bladder to the uterus, joining the incision through the broad ligament of one side with that of the other. The bladder is next separated from the anterior surface of the uterus, partly by blunt dissection and partly by cutting with scissors. Frequently at this point the dissection is close to the malignant growth. Care should be taken, on the one hand, to keep as far from the growth as possible; on the other, not to injure the bladder. If necessary, however, to get beyond the growth, a piece of the bladder can be resected. **If the bladder is found to be involved to any great extent the case is really an inoperable one and no further operation should be done other than the proper care of the wounds that have been made demands.**

When the bladder has been separated from the front of the uterus, the uterine vessels are exposed at the sides of the uterus and should be ligated and divided. Usually 2 or more ligatures are required on each side. The first ligature controls the artery as it turns upward at the side of the uterus, the second and lower controls a small branch that turns downward to the vagina. As the uterus is drawn upward, each uterosacral ligament can be felt as a tense band and should be ligated and divided and the peritoneum which is reflected from the uterus to the rectum is divided from the incised broad ligament of one side to that of the other. The uterus is now held only by its attachments to the vagina.

The bladder should have been pushed well down in front, and the rectal

attachment separated behind. It is usually not necessary to separate the rectum from the vagina. Not infrequently there is an advantage in placing another suture at each side of the vagina to control the upper vaginal vessels.

Before the vagina is opened gauze placed in it should be removed. It may also be washed out and sponged dry from below and painted with tincture of iodine. This requires only a moment of time and decreases the risk of infection. The vagina is best opened in front as low as possible without injury to the bladder. As soon as the anterior wall is sufficiently opened, it should again be sponged clean and painted with tincture of iodine. The uterus should then be entirely cut away, dividing the vagina as far from the growth as possible. The bladder fold of the peritoneum is sutured to the anterior vaginal wall and the rectal fold to the posterior vaginal wall. This covers the raw areas and controls all oozing. The 2 layers of the broad ligaments, first on one side and then on the other, are sutured together from the infundibulopelvic ligament to the side of the vagina. If the case is not to be drained, the anterior and posterior walls of the vagina are sutured together, care being taken to bring the peritoneal surfaces together to insure quick union. If the case requires drainage, a part of the top of the vagina is left open for the gauze drain.

If there has been no break in the technic and no injury to the surrounding organs, drainage is not necessary. If there has been injury to the bladder, rectum, or ureter, or if the malignant growth has been torn into before the vagina is cleansed and opened, a gauze drain through the top of the vagina is a safeguard.

Simple Vaginal Hysterectomy.—This operation is indicated in the woman of advanced years with a wide vagina and the one who, on account of her general condition, is a bad surgical risk. The operation is done less frequently now than in previous years, but is still indicated in certain cases.

Every effort should be made to avoid infection. The malignant growth should first be removed or destroyed. It is best to do this with an electric cautery, but frequently it is necessary to use a curet followed by the cautery. During the operation, care must be constantly taken not to infect the wounds either with pyogenic germs or with cancer cells. This is best accomplished by removing the uterus by the use of clamps on the vessels which are ligated and the instruments taken off after the uterus has been removed.

If the relative size of the uterus and vagina is favorable, that is, if the uterus is small and the vagina large, the uterus can be turned out through the anterior fornix, the vessels clamped from above downward, the posterior fornix opened from the peritoneum outward, and the uterus removed without the growth coming at any time in contact with the open wound. If the relative size is less favorable, the clamps have to be put on from below upward after both the anterior and posterior fornices have been opened, with the uterus in situ and with much greater risk of wound infection.

In the former case, that is, where the uterus can be turned out into the vagina, the operation is performed as follows:

A circular incision around the anterior half of the cervix is made, 1 or 2 cm. from the growth. The incision is joined at a right angle by one in the middle line of the anterior vaginal wall extending nearly to the urethra. Each flap is dissected back, exposing the bladder, which is pushed off the anterior surface of the uterus, and the vesical pouch of peritoneum is opened. The bladder is held up out of the way with a retractor, the cervix is pushed into the posterior fornix and the fundus turned out into the vagina. To turn the fundus of the uterus into the vagina, the cervix must be pushed back into the posterior vaginal fornix. The fundus cannot be drawn forward if the cervix is also held forward. **Three clamps on each side are usually sufficient to control the vessels and should be put on from above downward. The first is placed on the utero-ovarian ligament and tube, the second on the round ligament, and the third on the uterine vessels.** As each clamp is put on, the tissue between it and the uterus is divided, and this exposes the place for the next clamp. The uterus is held then only by the posterior vaginal wall. This is now divided, with the uterus still turned out into the vagina, from the peritoneal side and the uterus removed. If this technic is followed, the infected malignant growth does not at any time come in contact with the open wound surface. If the tube and ovary come easily into the wound, the first ligature should be placed outside of them on the infundibulopelvic ligament, and they should be removed. If they are not accessible, then the ligature should be placed just outside of the clamp on the utero-ovarian ligament and the tube and ovary left in place. A recurrence after an operation for carcinoma of the cervix rarely occurs in the appendages, so it is not essential that they should be removed. The second ligature is placed on the round ligament and the third on the uterine vessels, each just outside of the clamp. The remainder of the operation is the same as when the uterus is removed without first turning it into the vagina and will be described later.

When the relative size of the uterus and vagina is unfavorable, the uterus has to be removed without first turning it into the vagina. A circular incision is made entirely around the cervix at least 1 or 2 cm. from the growth. A second incision is made in the middle line of the anterior vaginal wall, extending from near the urethra to meet the first incision. The vaginal mucous membrane is dissected outward, and both the anterior and posterior fornices opened. A clamp is placed on the base of each broad ligament and should include the uterine artery. The uterosacral ligament of each side may be included in the first clamp or another may be placed on it. As the tissues between the clamp and the uterus are divided, the uterus comes down more into the vagina, and the round ligaments are exposed and clamped. A final clamp is placed on the utero-ovarian ligament and tube. The uterus is then cut away and removed. Clamps that have been placed on the vessels should be ligated and removed.

In closing the wound in cases of vaginal hysterectomy, it is usually not possible to suture the 2 layers of the broad ligaments together from the infundibulopelvic ligament to the side of the vagina, as is done in an abdominal hysterectomy. The bladder fold of peritoneum can and should be sutured to the anterior vaginal wall and the rectal fold to the posterior vaginal wall. Each round ligament, and if possible each infundibulopelvic ligament, should be sutured to the angle of the vagina. This diminishes the amount of raw surface. The anterior and posterior vaginal walls should be drawn together with 2 or 3 interrupted catgut sutures, but should not be completely closed, as all of these cases should have a small gauze drain for 2 or 3 days.

COMPLICATIONS OF OPERATIONS FOR CARCINOMA UTERI

Infection.—In either the abdominal or vaginal operations, irrespective of the care taken to prevent it, fresh wounds and the peritoneum are exposed to the infection of the sloughing, infected growth which it has been usually impossible to disinfect entirely. It has been claimed also that the parametrium may contain pyogenic germs which sometimes cause infection. The infection may occur beneath the broad ligaments, followed in some cases by a fatal peritonitis, or in the abdominal wound with interference with its healing.

Injury to the Bladder.—This is a frequent accident, especially in vaginal operations. It occurs usually in separating the bladder from the anterior uterine wall. At this point the growth in the uterus is close to the plane of dissection, and it is necessary to keep as far away from it as possible. In some cases it is better to resect a portion of the bladder wall, rather than to risk its sloughing. Any wound in the bladder should be at once sutured with 2 layers of catgut sutures. Sloughing of the bladder after the operation on account of interference with the blood supply has not occurred in any of my cases but is reported frequently in the literature.

Postoperative cystitis is a frequent and troublesome complication, especially in the radical abdominal operation on account of the interference with both the blood and nerve supply of the bladder and the long use of the catheter that is frequently necessary. In a number of my cases, it was necessary to catheterize the patient for 3 weeks following the operation, or nearly until the patient was out of bed. In these cases the possibility of a cystitis should be anticipated and steps taken to prevent it. Urotropin should be given after a few days. Dipping the catheter in a solution of argyrol before each catheterization is a wise precaution. If the cystitis develops, irrigation of the bladder should be instituted.

Injury to Ureter.—The ureter may be divided during the operation, or its blood supply may be so diminished that it may subsequently slough completely, or in part, forming a uterovaginal fistula. Probably in operations done for the removal of a cancerous uterus, when the ureters were not so commonly

exposed as at present, one or both ureters were not infrequently ligated and the accident never discovered.

In my personal experience and in my observation of the work of other surgeons, the ureter is more frequently divided in the upper part of its course near the uterosacral ligaments than lower down, either at the side of the uterus or in front, near its entrance into the bladder.

If the ureter is divided, the first choice for its repair should be to insert it directly into the bladder. This can be done only if it is divided low in its course and will reach the bladder without tension. The second choice is to anastomose the 2 ends, an operation requiring more time to perform, and one more likely to fail, than the insertion of the ureter into the bladder. The insertion of the divided ureter into the vagina, with the formation of a uterovaginal fistula, should be avoided if possible, as the result is a distressing one to the patient and often necessitates a subsequent operation to remove the kidney. The same is true of the insertion of the ureter into the rectum, as the ultimate result is often a septic nephritis requiring a nephrectomy. The removal of the kidney at the time of the primary operation is not advisable. The patient will already have had an extensive operation and should not have the additional shock of another. In one of my cases, the ureter was anastomosed but began to leak on the ninth day. A uterovaginal fistula persisted and was followed by infection of the kidney, which necessitated its removal. Sloughing of the ureter may occur as late as the tenth day.

END RESULTS

Several factors must be understood and taken into account in the consideration of end results of operations for carcinoma of the uterus.

Location of Disease.—Cases of carcinoma of the fundus uteri must be separated from cases of carcinoma of the cervix uteri. In the former group the prognosis is much better and there is a greater percentage of permanent cures than in cases of carcinoma of the cervix uteri. A malignant growth in the fundus of the uterus, especially if located in its upper part, is so situated that it, with a wide area of apparently normal tissue, can be removed without approaching vital structures. This is not so with cases of carcinoma of the cervix, as important organs are close to the growth. A division of the cases of carcinoma of the cervix depending upon the part of the cervix in which the growth starts would be a distinct advantage, but it is not practical, since most cases are so far advanced when seen that it cannot be determined in which part of the cervix the growth started.

Operability.—This term refers to the proportion of all the cases that come under an operator's care that he subjects to an operation. As the percentage of operability increases, more extensive cases are operated upon and

naturally the percentage of recurrences increases and of real cures decreases. Operability percentages from the European clinics are of greater value than from American hospitals. There, frequently, a given clinic is a medical center of a certain population area and a large proportion of all the cases of carcinoma of the uterus, both the operable and inoperable, go to that clinic and complete records are kept. Here the inoperable cases may be seen in a dispensary and never recorded in a hospital proper or the case may go from one hospital to another looking for relief and be recorded a number of times as an inoperable case. It is, however, the best criterion that we have by which we can compare the class of cases operated on by different men. It is of special value when the figures are those of men working under the same general conditions and in the same city or country.

The following table giving the percentages of operability of a number of European surgeons are average percentages:

Schauta	56 per cent.
Wertheim	50 per cent.
Doederlein	70 per cent.
Bumm	65 per cent.
Kuestner	30 per cent.
Thorn	45 per cent.
Kroenig	79 per cent.

A comparison of operability percentages of former years with those of the present shows that, since the radical operation has been done more frequently, more extensive cases are given the benefit of operation.

Primary Mortality.—The primary mortality from the radical abdominal operation for carcinoma of the cervix uteri is roughly between 10 and 25 per cent. It is high with the first cases of a series but diminishes considerably with the experience of the operator. Wertheim's mortality in his first 100 cases was 30 per cent., but for his first 500 cases it was 18.6 per cent.

The following table gives the mortality rates for a number of operators for the radical abdominal operation for carcinoma of the cervix uteri:

Wertheim	18 per cent.
Doederlein	18 per cent.
Bumm	25 per cent.
Kroenig	25 per cent.
Franz	21 per cent.
Zweifel	14 per cent.
Clark	8.3 per cent.
Peterson	20 per cent.
Taylor	10.7 per cent.

The mortality of the radical vaginal operation for carcinoma of the cervix uteri is decidedly less. Schauta's primary mortality for 11 years is 8.8 per cent. During the last 4 years, his mortality was 4.6 per cent. in 212 cases. These figures are much lower than the average. Staude, for example, has a mortality rate of 20 per cent., and the average rate is doubtless between these 2 extremes.

It is not easy to give the primary mortality of a simple abdominal or vaginal hysterectomy, as these operations are generally done on cases which are bad surgical risks and the mortality is largely dependent upon the general condition of the patient.

The mortality following hysterectomy for carcinoma of the fundus uteri is small, as these cases usually come to operation before the surrounding structures are involved. The operation itself produces but little more shock than any hysterectomy, and the mortality rate is determined largely by the general condition of the patient.

CURABILITY BY THE RADICAL OPERATION

Two expressions, namely, "relative cures" and "absolute cures," must be understood in order to properly comprehend the statistics on operations for carcinoma of the uterus. By "relative cures" is meant the percentage of cases that were operated upon during a certain period that are free of recurrence at the end of 5 years. By "absolute cure" is meant the percentage of all cases seen during a given period, regardless of whether an operation was performed or not, that are free of recurrence at the end of 5 years. Naturally the percentage of "absolute cures" is much less than that of "relative cures." This is illustrated by statistics from Zweifel's clinic as follows:

During a certain period 222 cases of carcinoma of the cervix were under observation, of which 115 cases were operated upon and 52 were free of recurrence at the end of 5 years, that is, 45.2 per cent. of the cases operated upon or 45.2 per cent. of "relative cures" and 23.4 per cent. of the cases seen or 23.4 per cent. of "absolute cures."

The following tables taken from Doederlein and Kroenig's "Operative Gynäkologie" give the results of a number of European operators both for the abdominal and vaginal radical operations for carcinoma of the cervix uteri:

ABDOMINAL

OPERATOR	ABSOLUTE CURES	RELATIVE CURES
Zweifel.....	23.4 per cent.	45.2 per cent.
Doederlein.....	17 per cent.	28 per cent.
Bumm.....	16 per cent.	26.3 per cent.
Kroenig.....	25.3 per cent.	32.2 per cent.
Wertheim.....	18 per cent.	42.4 per cent.

VAGINAL

OPERATOR	ABSOLUTE CURES	RELATIVE CURES
Schauta.....	16.4 per cent.	45.2 per cent.
Staude.....	20 per cent.	30 per cent.
Thorn.....	16.3 per cent.	43 per cent.

Care must be taken not to confuse the statistics of carcinoma of the fundus uteri with those of carcinoma of the cervix uteri. The results of the former are far more favorable than the latter, even though a less extensive operation is usually done, as indicated by the following table:

CARCINOMA OF THE FUNDUS UTERI

OPERATOR	PERCENTAGE OF CURES
Zweifel.....	66.6 per cent.
Schauta.....	83.3 per cent.
Doederlein.....	100 per cent.
Runge.....	66 per cent.

CAUSES OF DEATH

The causes of death following radical abdominal hysterectomy for carcinoma of the uterus are best seen by a study of Wertheim's statistics, from which the following table has been taken. He had 93 deaths in 500 operations as follows:

Peritonitis	39 cases
Feeble heart and cachexia.....	22 "
Pyelonephritis	9 "
Embolism	5 "
Pyemia	3 "
Postoperative hemorrhage	2 "
Ligature of ureters.....	1 "
Miscellaneous	12 "
Total.....	93 cases

The most frequent cause of death, over 33 per cent. of the entire number, is seen to be infection, usually directly from the primary carcinomatous focus, which has been insufficiently disinfected and broken into, or from the vagina

after it has been opened. Wertheim lays special stress on the use of his right-angle clamps for shutting off the growth in the upper part of the vagina before it is opened. This unfortunately is not always possible on account of want of room, in which case the vagina should be irrigated and cleansed from below before it is opened and again disinfected from above as soon as the uterus is removed. It is possible that there are pyogenic organisms in the parametrium, either before the operation or as a result of handling during the operation, which would account for some cases of infection which occur regardless of technic which has apparently been without fault.

Cardiac disease and cachexia are second in frequency as causes of death following the operation and constitute nearly 25 per cent. of Wertheim's deaths. Doubtless there are included under this heading cases usually ascribed to shock from loss of blood, old age, arterial changes, etc.

Nine of the deaths or about 10 per cent. occurred from pyelonephritis, the result of injury to the ureter or bladder. The other causes of death are the same as from any extensive abdominal operation.

TREATMENT OF INOPERABLE CANCER OF THE UTERUS

Cautery.—There is no treatment for carcinoma of the fundus or cervix of the uterus, other than its removal by operation, that is equal to that obtained by the use of the actual cautery. The beneficial results of its use are obtained partly by the absolute destruction of the cancerous tissue by the cautery, and partly by heating the adjacent tissue to a degree that will kill or inhibit the cancer cells without destroying the normal tissue cells. This fact, that cancer cells can be killed by heat without the entire destruction of the tissue in which they are located, was advanced over 20 years ago by Byrne as an explanation of the favorable results obtained by him in the treatment of carcinoma of the cervix with the cautery. The same explanation is probably the correct one for the beneficial effects of the radio-active substances that are being used at the present time in the treatment of malignant growths. By the use of the cautery, some cases previously inoperable, with a uterus firmly fixed by the parametritic exudate, are so changed that the induration disappears, the uterus becomes movable, and the case is a suitable one for a radical operation. To obtain proper results it is necessary to have a cautery of sufficient size and power not only to destroy the cancerous tissue but also to radiate heat into the adjacent tissue. The electric cautery is the best, as the heat from it is more constant and controllable. Cautery irons similar to those used by plumbers give good results. The ordinary Paquelin cautery is not of sufficient size to give proper heat.

The growth is exposed through a cylindrical speculum, preferably with a water jacket to prevent its overheating and burning the vulva and lower part of the vagina. Such parts of the malignant growth as are readily accessible

may be separated with the cautery knife. The deeper and less accessible parts are destroyed with the larger cautery dome. Care should be constantly taken that the cautery is not raised to too high a temperature, and the work should be done slowly. With a low degree of heat, blood-vessels are occluded before they are divided, hemorrhage is avoided, and the necessary dry field is obtained. Furthermore, and this is a most important point, by a lower degree of heat maintained for a longer time, sufficient heat to destroy cancer cells without the destruction of normal tissue cells will penetrate the deeper tissues. Byrne, 20 years ago, and Percy, who has developed this technic more recently, both emphasize the necessity of low heat of long duration to obtain the best results.

Local Application.—To control discharge in the later stages of the disease, it is necessary to rely on douches and local applications. For local applications acetone, as suggested by Gellhorn, has given the best results in my experience. With the patient in the dorsal position with the hips elevated or else in the knee-chest position, a cylindrical speculum is inserted into the vagina. The acetone is poured into the speculum and allowed to remain in direct contact with the malignant growth from 3 to 15 minutes, depending on the amount of pain given to the patient. The effect of the acetone is to harden or tan the tissue and to diminish the discharge, but it does nothing to limit the progress of the disease.

CHAPTER XIV

OPERATIONS FOR DISPLACEMENTS OF THE UTERUS

WM. E. STUDDIFORD

GENERAL CONSIDERATIONS

The normal position of the uterus when the woman is in the upright position, with the bladder and rectum empty, is one of slight ante flexion. The anterior surface of the organ rests on the bladder and the axis of its body lies almost horizontal just below the level of the symphysis, forming a slight angle with the axis of the cervix which points downward and backward toward the last sacral vertebra, making an acute angle with the long axis of the vagina. This position of the uterus is subject to wide variations within the bounds of health, such variations being largely dependent upon the condition of the neighboring organs (the bladder and rectum) or the physiological changes (menstruation and pregnancy) of the uterus itself.

There is no doubt that many women have displacements of the uterus for long periods of time without unpleasant symptoms, but as a rule such displacements, if constant, eventually bring about changes in the circulation and function of the uterus, or disturbance of function in neighboring organs that cause them to seek relief; therefore, treatment of any form of uterine displacement depends not only upon a careful study of the causes of the displacements, but upon a clear conception of the forces that maintain the uterus in its normal position. These forces are: (1) *the uterine ligaments*; (2) *pelvic floor*; (3) *intra-abdominal pressure*.

The Uterine Ligaments.—Three sets of ligaments are concerned in the maintenance of the position of the uterus, viz., the sacro-uterine, the broad, and the round ligaments. The term ligaments is misleading. The essential supporting structures in all are the involuntary muscle fibers projected from and continuous with the musculature of the uterus. These fibers, by their origin from the uterus, their attachment to the pelvic wall, and by reason of their increase in size and strength during pregnancy, are not only of importance in supporting the uterus, but have a distinct function to perform during labor, that is, aiding in the dilatation of the cervix and maintaining the axis of the uterus in line

with the axis of the pelvis. They are subject to injury during labor and undergo the same involutionary changes as the uterus after labor. This function of the so-called ligaments is often forgotten when considering their supporting power.

The *sacro-uterine ligaments* contain numerous bands of muscle fibers given off from the posterior surface of the uterus at about the level of the internal os and attached to the sides of the second sacral vertebrae, that by their action aid in drawing the cervix backward and upward toward the promontory of the sacrum.

The *broad ligaments* contain many bands of involuntary muscle fibers, some of which are grouped about the ovarian arteries and connected with the round ligaments. The most important, however, lie at the base of the broad ligaments projecting from the sides of the cervix at about the level of the internal os, some of the fibers interlacing with muscular fibers from the sacro-uterine ligaments, and with fibers from the upper part of the vagina. They are attached to the side walls of the pelvis at about the level of, or a little above, the white line. These bands of fibers, often markedly developed, called by Mackenrodt the *ligamentum latum colli*, are the most important structures connected with the uterus itself, giving lateral support and preventing the descent of the organ. Their injury during labor or by inflammatory changes has a distinct bearing on subsequent displacements.

The *round ligaments* are well formed, muscular bands, projecting from the lateral anterior surface of the uterus below the insertion of the fallopian tubes, passing outward through the anterior folds of the broad ligaments to the internal abdominal ring, then through the inguinal canal, where some of the fibers are attached to the floor of the canal, other fibers passing out at the external ring to be inserted in the deep fascia of the external genitals. The round ligaments are probably called upon, not for supporting power, but to limit the excursions of the uterus caused by distention of the bladder or rectum. During pregnancy they become markedly enlarged and, at their origin from the uterus, develop great strength, enabling them to steady the position of the uterus and, during labor, aid in maintaining the axis of the uterus in line with the axis of the pelvis.

Anteriorly, the attachments of the bladder to the uterus contain many muscle fibers that are principally concerned in maintaining the relation of the two organs and in supporting the position of the bladder.

The attachments and structure of these three sets of ligaments are such that the cervix is held in its normal position in the pelvis, and the backward and lateral movements of the body of the organ are restrained. The skiagraph of the pelvis after an Outerbridge wire pessary had been introduced into the cervical canal of a movable retrodisplaced uterus gives a striking demonstration of the rotation of the uterus upon a transverse axis running through the internal os on about the plane of the musculoligamentous attachments to the cervix. It will be noted in the composite skiagraph that the tip of the wire



A.—Uterus in retrodisplacement.



B.—Uterus in antelexion supported by pessary.



C.—Composite print of plates A and B.



D.—Uterus in antelexion, taken 3 weeks after Alexander's operation. Position of stem-pessary about same as in B.

FIG. 1.—SKIAGRAPH OF PELVIS IN WHICH AN OUTERBRIDGE STEM HAS BEEN PLACED IN CERVIX OF A MOVABLE RETRODISPLACED UTERUS.

passary has changed very little in position with the body of the uterus in either posterior or anterior position. The muscular fibers take part in the enlargement of the uterus during pregnancy, and have definite functions to perform during labor. The adjustment is so evenly balanced that little or no strain comes upon any of the muscular fibers of the ligaments, provided the pelvic floor and the intra-abdominal pressure are normal, and, like involuntary muscles elsewhere, they automatically respond to the ordinary pressure placed upon them, to maintain the position of the uterus.

Pelvic Floor.—The muscles and fascia of the pelvic floor, by their ability to close the vaginal slit and cause an upward pressure on the structures above them, aid the uterine ligaments in supporting the uterus by limiting its descent and protecting them from overstrain. Under severe pressure from above, this support is augmented by pressure on the tissues of the ischiorectal fossa by the gluteal muscles. Injury to the pelvic floor, by interfering with its supporting power, may place undue strain on the uterine ligaments, so that they eventually become weakened and allow the uterus to become displaced.

Intra-abdominal Pressure.—The position of all the abdominal organs is dependent upon the strength and development of the containing walls of the abdominal cavity, and so long as the muscular and fascial structures of these walls are intact, the pressure is evenly distributed in all directions. Little or no strain is placed upon the supporting structures of any of the abdominal organs. The uterus, by reason of its position in the pelvis, receives the intra-abdominal pressure on its *posterior or upper surface*, so that any increase in pressure, when the ligaments and pelvic floor are normal, tends to maintain its anteфлекed position.

The interdependence of these three supporting forces is so intimately blended and so finely adjusted in maintaining the position of the uterus, that treatment of displacements of the organ must be based not only on procedures that restore it to a normal position, but so far as possible, correct and strengthen all the forces that are in error.

Lacerations of the cervix, often involving the muscles at the base of the broad ligaments (the ligamentum latum colli), must be repaired by trachelorrhaphy or amputation. The supporting power of the pelvic floor must be restored by suitable operative procedures.

Habits of posture and dress that increase intra-abdominal pressure must be corrected. Too much attention cannot be paid to the correction of badly directed corset pressure. The works of Dickinson and Reynolds and Lovett on this subject can be studied with profit. The effect of corset pressure can often be easily determined on the examining table by vaginal examination, first with the corset in place and again after its removal. **It is surprising at times to note the amount of elevation in the pelvis that takes place in the uterus after the pressure has been released.** Should faulty corset pressure be determined as a contributing factor in causing the displacement, instructions should be given as

to the kind of corset that will relieve the condition. Such a corset is well described by R. L. Dickinson:

"In general there should be the least possible downward pressure on the internal organs; no undue tightness and no forward carriage of shoulders or droop of chin as a result of wearing a particular corset. The designs to be preferred show the front straight, with little or no incurve at the waist, long below, reaching nearly to the pubic bone; back curved, low at top; separate lace for lower six or eight holes. Pressure should be greatest around the hips, carefully and snugly adjusted, diminishing above this zone, being less at the waist line than below the waist. The lower ribs must have play. With regard to posture or carriage the shoulders must not be thrown forward and hips backward, the comparison being made first in undershirt and then after the corset is put on. Large or relaxed breasts are to be supported independently from the shoulders. Front or back lacing has to be chosen for the particular case. A stock corset may often be altered to suit the above, as well as to meet individual requirements. When taken off, laces must be loosened; when front lacing permits, women with large or relaxed abdomens should put on the corset while lying on the back, raising the body on the heels to send the organs upward. In any case lacing should always begin at the lower edge. To reach downward inside the corset and raise the abdomen before tightening is another method of attempting the same end."

For active work that involves stooping or lifting, a short flexible corset that supports the pelvic girdle, or an abdominal belt such as is used by many female dancers and acrobats should be worn. Neglect on the part of the surgeon to pay attention to this correction of faulty intra-abdominal pressure will often result in his failure to relieve the disturbing symptoms after operation and, if allowed to continue, may be a cause for recurrence of the displacement.

ANTEFLEXION OF THE UTERUS

Prophylaxis.—Symptom-producing antelexion of the uterus is as a rule the result of nutritional and developmental causes. Undoubtedly in many cases it could be prevented if proper care had been taken at the time of puberty when the causes are most active. Too often the onset of the menstrual function, like its cessation at the menopause, is governed by false tradition and the physician is not consulted until serious conditions have developed. The changes that take place in the uterus at the time of puberty which are finally evidenced by the establishment of the menstrual function make the organ especially susceptible at that time to nutrition and habit influences. Fresh air and exercise, physical rather than mental training should predominate in the life of the growing girl at that time. She should be given simple and nourishing food. Attention should be paid to posture, both while standing and sitting. The muscles of the thorax and abdomen should be developed by suitable exercises. Constipation with its attending muscular strain, felt most on the pelvic organs, is to be avoided. Rest at the menstrual periods should be insisted upon, especially when the

function is attended by irregularity or pain or marked nervous disturbances. Waist constriction is to be avoided and if corsets are used, only those of flexible and light construction, fitted to the hips and causing no downward pressure, should be worn. Instructions given to mothers and guardians of young girls, calling their attention to the necessity of this care, will, if carried out, prevent many cases of poorly developed or anteфлекed uteri with accompanying symptoms of dysmenorrhea and sterility. Where anteфlexion has developed and relief is sought for dysmenorrhea or sterility or both, careful investigation of underlying causes should be made before surgical treatment is instituted. Many of those patients are neurotic and an ill-advised or hasty resort to operative procedure will often leave them worse off than they were before—often a prey to “quacks” and drugs. The adnexa should be carefully examined and if possible excluded as causative factors of the symptoms. If involved, suitable treatment should be instituted. The influence that occupation, habits, dress, and general physical condition have on the disturbances of position and function of the uterus must be considered. If sterility is the pressing symptom, no operative procedure should be undertaken until the virility of the husband is ascertained.

All plans of surgical treatment of the dysmenorrhea and sterility, associated with anteфlexion, have for their object a dilatation and straightening out of the uterine canal.

Dilatation of the Cervical Canal and Curettage.—Under general anesthesia, with the patient in the lithotomy position, the vagina and external genitals are washed with soap and sterile water, then dried and painted with a solution of alcohol and tincture of iodine, equal parts. The pelvic organs are then thoroughly examined to make sure that the adnexa are not involved. A Sims speculum is introduced, care being taken in unmarried women not to rupture the hymen. If ruptured, at the completion of the operation it should be repaired by one or two sutures of fine catgut after the withdrawal of the speculum. The anterior lip of the cervix is grasped with tenaculum forceps. The cervical canal is then carefully dilated with a branched dilator. This should be done slowly so that the constriction at the internal os is thoroughly overcome. The interior of the uterus is gently curetted, first with a blunt curet, and should the endometrium be found thickened, a sharp curet may then be substituted, care being taken not to go deeply into the muscular structures of the uterus. Several cases are on record of permanent amenorrhea following this procedure due to the removal of the entire endometrium by too vigorous use of the sharp curet. This tissue, removed by the curet as in all cases where curettage is performed, should be submitted to pathological examination to make sure that no unsuspected disease of the uterus exists. After the curettage, the interior of the uterus is wiped out with a strip of gauze saturated with a solution of tincture of iodine and alcohol, equal parts, introduced by means of either an applicator or uterine dressing forceps. If the flexion is slight and the constriction found at the internal os is not marked, this procedure may be

sufficient to relieve the symptoms. This relief may only last for a few months unless contributing causes that have brought about the antelexion can be entirely removed or, in cases of sterility, impregnation does not take place. Should impregnation take place, however, a permanent cure of the condition may be expected.

Uterine Stem Pessary.—If the constriction at the internal os is marked and the cervix is not elongated or sharply antelexed, good results may be obtained by introducing an intra-uterine stem pessary. These pessaries are made of various materials, hard rubber, metal and glass, differing in shape and size and constructed with or without drainage slits. My own preference is for the solid rubber stem devised by Davenport, which is easily sterilized and can be readily held in place. The stem should be of sufficient length to pass well beyond the internal os, but not long enough to reach the upper border of the uterine cavity. It should be introduced under general anesthesia, the same preparation being made as for curettage, the cervix being first thoroughly dilated and the uterus curetted with a blunt curet. The stem, threaded with two silk ligatures armed with small full-curved trocar-pointed needles, is then introduced through the dilated cervix and held in place by the ligatures, one passing through the anterior and the other through the posterior lip of the cervix. This operation is best performed about one week before an expected menstrual period, so that the patient can be under observation at that time. The patient should be kept in bed until the pain has subsided or, if the menstrual period intervenes, until the flow has stopped. If the stem causes no disturbance and the pain at the menstrual period has been relieved, the patient may be allowed out of bed and may gradually resume her ordinary duties. The stem may be left in place for one or two months, the patient reporting for examination from time to time. She should be instructed to take a douche of two quarts of sterile water in which two tablespoonfuls of boric acid powder have been dissolved, two or three times a week. This douche should be taken while lying in the dorsal position with the fountain syringe elevated not more than two and a half feet above the hips, so that the pressure is not great enough to force any material from the vagina past the stem into the uterine cavity. In cases in which the stem is used, every effort should be made to eliminate any inflammatory condition of the tubes and ovaries, as many cases are recorded in which such inflammatory conditions have been lighted up by the presence of the stem in the uterus and serious results have developed.

The Dudley-Reynolds Operation.—In that class of antelexions in which the angle between the body of the uterus and the cervix is very acute and which are described as really antelexion of the cervix, the cervix often being elongated and pointing forward in the axis of the vagina, more radical procedures must be instituted to straighten out the uterine canal. The one most commonly practiced and offering the best and most prompt relief of the symptoms is that described by E. C. Dudley and later modified by E. Reynolds. Under general anesthesia, the genital tract having been sterilized by the use of tincture of iodine

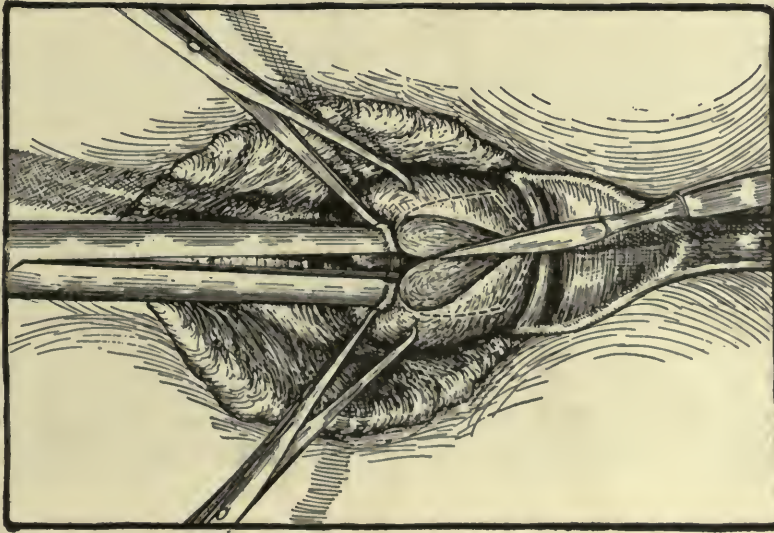


FIG. 2.—INCISION OF POSTERIOR LIP OF CERVIX. Dotted lines mark wedge-shaped pieces to be excised.

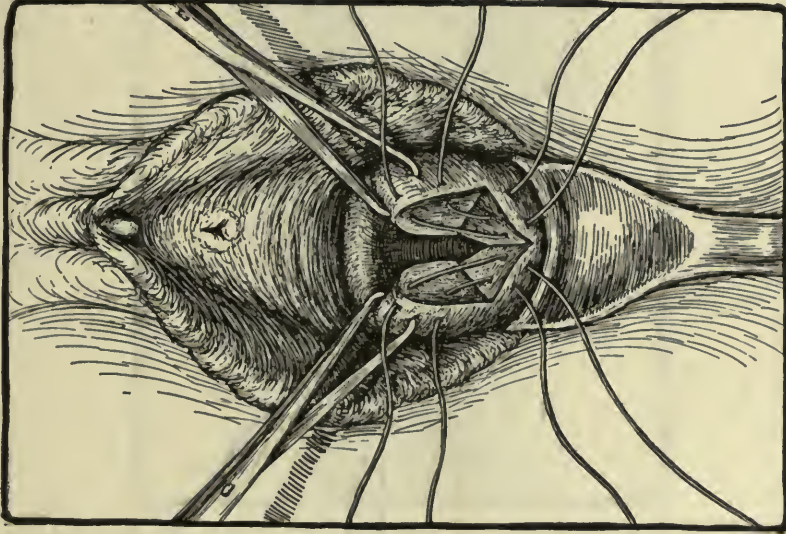


FIG. 3.—WEDGE-SHAPED PIECES REMOVED. Sutures in place.

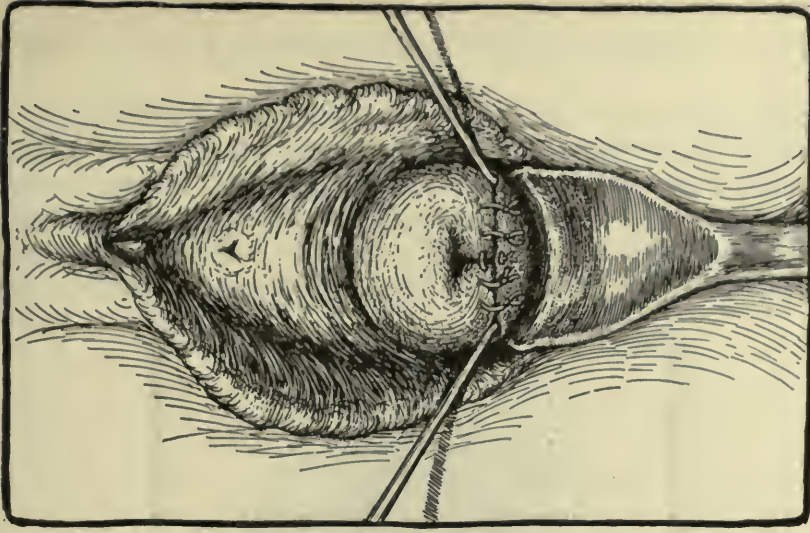


FIG. 4.—SUTURES TIED. Extra suture to bring edges of external os in place and tied.

and alcohol, equal parts, a perineal retractor is introduced and the posterior lip of the cervix at the external os is grasped on either side of the median line with tenaculum forceps. The cervix is then thoroughly dilated with a branched dilator, the interior of the uterus curetted with a blunt curet and wiped with gauze saturated with iodine and alcohol. The dilator is then reintroduced, the blades moderately separated and the handles held forward under the arch of

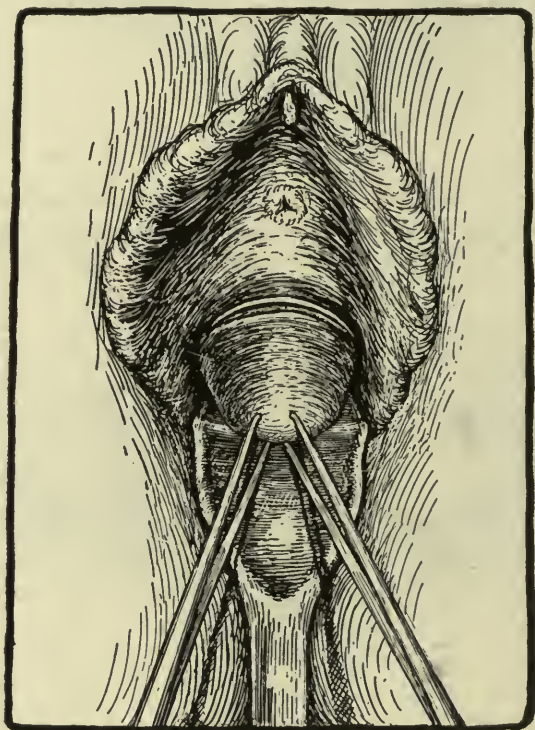


FIG. 5.—TRANSVERSE INCISION JUST BELOW CERVICOVAGINAL JUNCTION.

the symphysis by an assistant. With a scalpel or straight scissors, using the dilator as a guide, the posterior lip of the cervix is divided in the median line from the external os almost to the cervicovaginal junction posteriorly and through the fibers of the internal os anteriorly. A wedge-shaped piece is then excised from either half of the posterior lip of the cervix, as outlined in Figure 2, the base of the wedge being on the cut surface and the broad angle of the wedge about midway between the external os and the posterior end of the incision. Two 20-day chromic gut sutures are then introduced on either side, as shown in Figure 3. The angles of the wedges are pulled outward and backward by tenacula and the stitches tightened and tied. This causes the edges of the external os to be drawn backward toward the original cervicovaginal junction, the cervix itself is drawn backward into the vagina and the cervical canal is straightened. An additional stitch may be introduced for

approximating the two edges of the cut external os to the edges of the cervical tissue near the vaginal junction. When, as shown by Reynolds, the antelexion of the cervix is due to the shortness of the anterior vaginal wall or spasm of the muscular fibers connecting it with the bladder and uterus, the effacement of the angle between the cervix and the body of the uterus may be further increased by an incision in the anterior vaginal wall. The anterior lip of the cer-

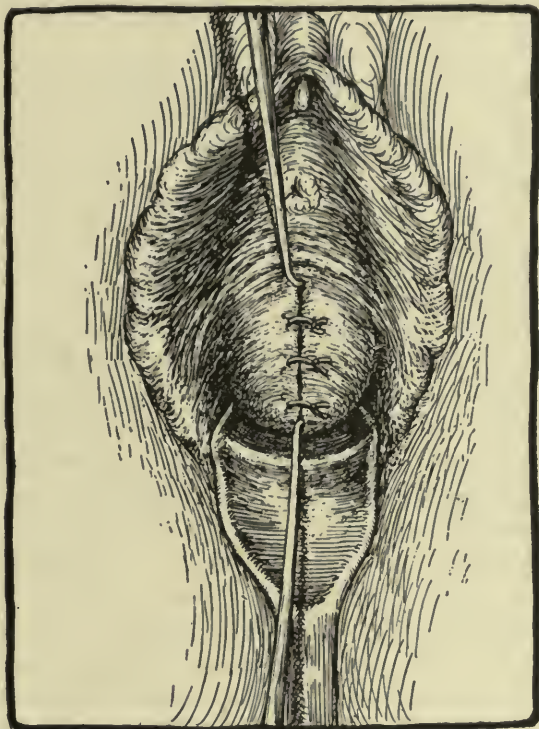


FIG. 6.—TRANSVERSE INCISION SUTURED LONGITUDINALLY. Lengthening the anterior vaginal wall and pushing the cervix upward and backward.

vix is grasped about $\frac{1}{2}$ in. below the cervicovaginal junction, the cervix is pulled downward, and a transverse incision, $\frac{3}{4}$ in. in length, made just above the junction of the cervicovaginal mucous membrane. This incision is made through the vaginal wall and by blunt dissection with the gloved finger wrapped with gauze, the tissue lying between the vagina and bladder and uterus is separated and pushed upward about $\frac{1}{2}$ in. in the median line and at either angle of the incision. This causes a loosening not only of the vaginal attachment, but of the attachment to the bladder and the uterus. Frequently there is sharp venous bleeding, but as a rule this can be neglected, as it is quickly controlled by pressure and the closure of the vaginal incision. This closure is made by seizing the midpoint of the upper and lower margins of the incision of the vaginal wall with tenaculum forceps and the wound which was made trans-

versely is closed longitudinally, care being taken that the sutures pass only through the vaginal structures not including the tissues underneath. The effect of this procedure is to throw the cervix further backward in the vagina and to lengthen the anterior vaginal wall. These patients should be kept in bed for a week or ten days after the operation. The results of the operation from various reporters show that it relieves dysmenorrhea in from 60 to 75 per cent. of the cases and that sterility is relieved in from 15 to 30 per cent.

RETRODISPLACEMENT

Prophylaxis.—Just as antelexion is often the result of lack of care during the developmental life of the uterus, so retrodisplacements are most frequently the result of lack of care during its life of functional activity. Suitable precautionary measures during pregnancy, labor and the puerperium or after abortion will prevent many cases of backward displacement of the uterus. The conscientious obstetrician should see to it that the pregnant woman has abdominal support by a corset or bandage during the later months of pregnancy to relieve strain upon and overstretching of the abdominal muscles; that immediate repair is made of lacerations of the cervix and pelvic floor after labor; that passive or mild active exercise is instituted to strengthen the abdominal muscles and the knee-chest posture assumed to relieve pressure on the uterine ligaments during the latter part of the lying-in period; that waist constriction is avoided and the abdominal muscles supported by a suitable bandage after the patient assumes the upright position; that careful attention is paid to corset pressure when this article of dress is resumed.

Retrodisplacement is most apt to develop during the second month post partum. A thorough and routine vaginal examination should be made at the sixth and eighth weeks after labor and, if retrodisplacement is found, efforts should be made to immediately replace the uterus. This as a rule is easy of accomplishment either bimanually with the patient in the dorsal position or by having her assume the knee-chest posture. A suitable pessary should then be inserted to maintain the uterus in position. Should the uterus be unduly enlarged and tender to pressure, a sterilized wool tampon, wetted with a 10 per cent. solution of boroglycerid in glycerin, should be inserted into the posterior vault of the vagina, preferably while the patient is in the knee-chest posture. This tampon should remain in place for 24 hours and then be removed. A warm boric acid douche should be given and another tampon inserted, first being assured that the uterus is still in antelexion. This treatment should be continued until the tenderness has disappeared, usually for a week or ten days, and then a pessary should be inserted. The most satisfactory pessaries are those of hard rubber, of the Smith or Thomas type or one of flexible construction made of copper wire covered with celluloid that can be molded and shaped without heating, or the soft rubber ring. A daily douche of one quart of warm

water, to which has been added one or two teaspoonfuls of salt or borax, should be used for cleansing purposes. Otherwise there may be some odor to the secretion caused by the presence of the pessary. This is especially true if the soft rubber ring is used. The knee-chest posture should be assumed for 5 or 10 minutes, night and morning. If the pessary supports the uterus in position and is worn without discomfort, its use should be continued for from four to six months or until involution is well established. The condition of the pessary should be examined every three or four weeks to be sure that it is performing its task and causing no irritation of the vagina. Should such irritation develop, the pessary should be removed and tampons resorted to until it has subsided. At the end of 4 or 6 months the pessary should be removed for the purpose of testing the uterine supports. The patient should be kept under observation for several months longer, examinations being made at frequent intervals to see that there has been no recurrence of the displacement. Should such recurrence take place and uncomfortable symptoms develop, the patient should then be given her choice of continuing a pessary life with a doubtful prospect of relief, or a safe operative procedure with an almost certain outlook for permanent cure. It is in this type of cases that the external shortening of the round ligaments is indicated and gives the most satisfactory result. We know that the uterus is movable and free from adhesions because the pessary will hold it in place and relieve uncomfortable symptoms and at the same time cause no discomfort, which is evidence that no adhesions or disease of the adnexa exist. The frequent examinations made during the treatment by pessary will have confirmed this evidence.

EXTERNAL SHORTENING OF THE ROUND LIGAMENTS

Contra-indications.—In cases in which there is disease of the adnexa or adhesions to either the uterus or adnexa; in nulliparous women in whom the ligaments may be poorly developed; in elderly women past the menopause, where there is atrophy of the ligaments; in any case in which there is doubt as to the mobility of the uterus and the condition of the adnexa, the operation should not be performed without opening the abdomen.

Alexander's Operation.—Under general anesthesia, injuries to the cervix and pelvic floor having been repaired, the uterus is placed in its normal position by bimanual manipulation. The patient should then be draped as for eeliotomy and the lower abdomen, the groins and the upper parts of the thighs painted with equal parts of tincture of iodine and alcohol. The spine of the pubis on the left side is now located and with this as a guide an incision about $1\frac{1}{2}$ to 2 in. in length, dependent upon the amount of subcutaneous fat, is made through the skin and superficial fascia, care being taken to ligate any bleeding points in the course of the incision. The direction of the incision should be on a line drawn between the spine of the pubis and the anterior superior spine of the ilium. The edges of the wound are retracted, the deep layer of the superficial



FIG. 7.—EXTERNAL RING EXPOSED. Showing terminal fibers of round ligament, and the genitocrural nerve below it.

fascia incised until the glistening fibers of the external oblique are exposed and the external ring located. The tissues connected to the pillar of the ring are then

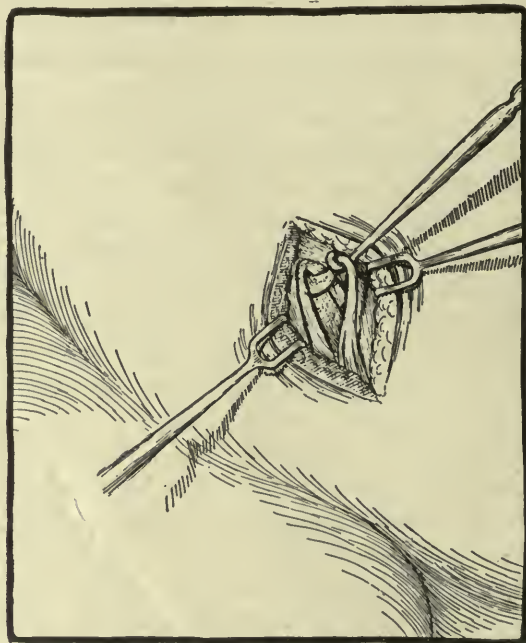


FIG. 8.—ROUND LIGAMENT ELEVATED BY A BLUNT HOOK.

carefully freed. As a rule after this exposure the terminal fibers of the round ligament come into view together with the genital branch of the genitocrural nerve accompanying the ligament in its course through the canal. Carefully separating the nerve, the ligament is grasped with tissue forceps or a blunt hook, or an aneurysm needle may be passed underneath the ligament. This can often be facilitated by elevating the upper angle of the external ring with a blunt hook. Making firm traction on the ligament, separating the surrounding tissue with blunt forceps, the ligament is gradually drawn from the canal until the peritoneal pouch appears at the external ring. This is pushed back

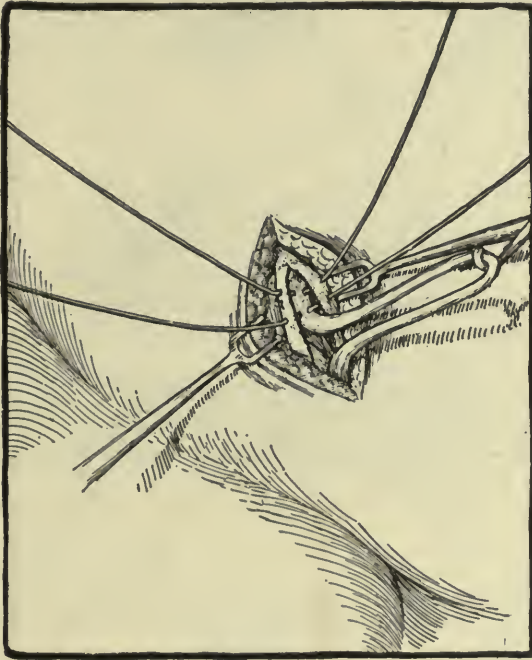


FIG. 9.—SUTURES IN PLACE, FASTENING THE ROUND LIGAMENT TO THE PILLARS OF THE EXTERNAL RING.

with a gauze pad saturated with saline solution until the thick uterine end of the ligament is reached. Care should be taken with the lower fibers of the ligament, some of which may be inserted into the floor of the canal and must be loosened before the ligament runs freely. The ligament is then looped over a pad wet with warm saline solution; the round ligament on the right side is found and drawn out by the same procedure. With both ligaments exposed they are then placed upon the stretch until the hand of an assistant can feel by slight pressure the presence of the fundus under the abdominal wall in the median line. This may not be possible if there is a large amount of subcutaneous fat, in which case the judgment of the operator and the size of the ligament will have to be the guides in determining whether the ligaments have been sufficiently shortened. As a rule from $3\frac{1}{2}$ to 5 in. of ligament are with-

drawn. Care should be exercised during the withdrawal of the ligament not to bruise it by vigorous forceps compression and, if possible, not to separate its

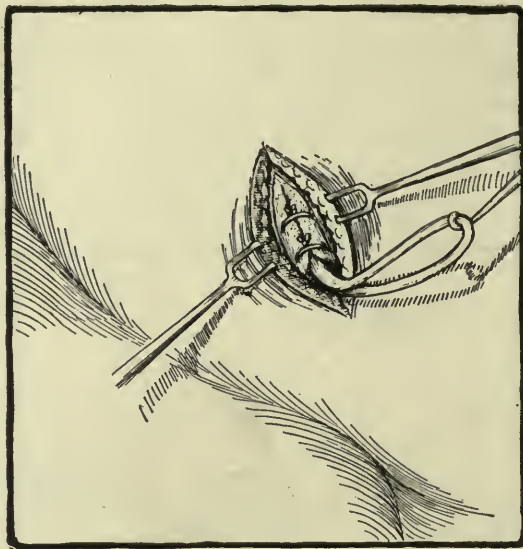


FIG. 10.—SUTURES TIED, FASTENING THE ROUND LIGAMENT TO THE EXTERNAL RING.

terminal attachment to the fascia. Such separation, should it occur, is not a serious matter. The ligament is then anchored to both pillars of the external

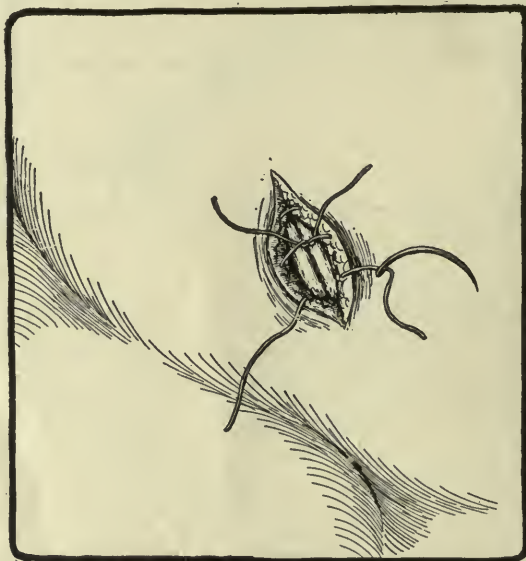


FIG. 11.—LOOP OF ROUND LIGAMENT FOLDED UPON FASCIA OF EXTERNAL OBLIQUE. Sutures through the deep layer of superficial fascia in place.

ring by two or three interrupted chromic catgut sutures, care being taken not to include the whole thickness of the ligament in the sutures and thus inter-

fere with its blood supply. The redundant portion of the ligament, if it has not been freed from its terminal attachment or badly bruised, is then folded upon the fascia of the external oblique and fastened to the deep layer of the superficial fascia by a continuous catgut suture. If the ligament has been freed from its lower attachment or bruised, a ligature should be tied around it about half an inch from the ring and the distal end cut off, the stump of the ligament being fastened to the deep layers of the superficial fascia by a continuous catgut suture. Should the ligament break during its withdrawal, the

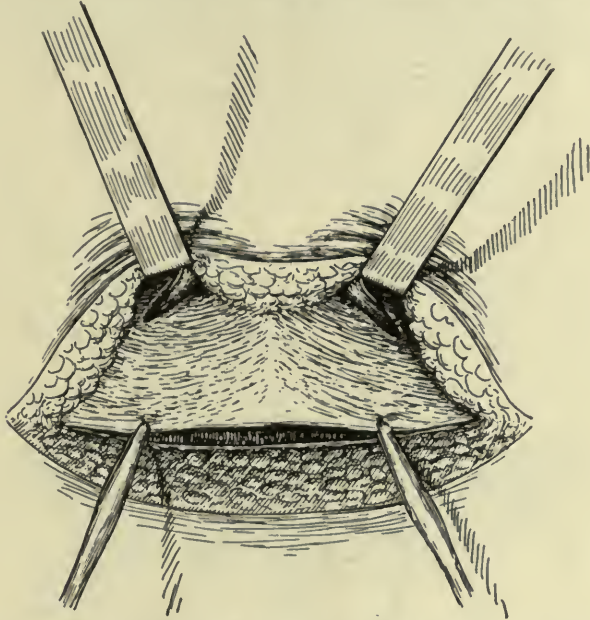


FIG. 12.—LOWER PORTION OF ABDOMINAL FASCIA HELD BY FORCEPS. Superficial fascia freed and retracted, exposing the external rings and the ends of the round ligaments.

inguinal canal should be opened by splitting the fascia of the external oblique and the torn ligament found at the internal ring, and stitched to the fascia or pillars of the ring and the canal closed by interrupted chromic sutures. The skin wounds are then closed either by silk sutures or subcutaneous sutures of catgut. Care must be taken in protecting the wounds, as their position near the groin allows the dressings to be easily misplaced. In some cases in addition to adhesive straps a hip-spica may be necessary. The symptomatic and anatomical results of this operation are most satisfactory. Many reported series of cases show perfect anatomical results even after subsequent labor and the operation itself adds no complication to future pregnancy or labor. The danger of hernia developing in the wounds after the operation is no greater than after celiotomy, especially if the canal has not been opened. In my experience the round ligaments are usually well developed in women who have borne children, and in cases of prolapse they are often markedly enlarged and are not difficult either to find or withdraw from the canal.

EXTERNAL SHORTENING AFTER CELIOTOMY

Cases of retrodisplacement in which there is doubt as to the presence of adhesions holding the uterus backward or as to the condition of adnexa, or where diseased adnexa or other intra-abdominal conditions are known causative factors in the displacement, external shortening of the round ligaments can be accomplished by another method. With the abdomen opened by a Pfannenstiel incision, the center of the incision being made about $1\frac{1}{2}$ to 2 in. above the upper border of the symphysis and extending outward upon either side with a slight upward curve, the uterus and its appendages are exposed and the intrapelvic

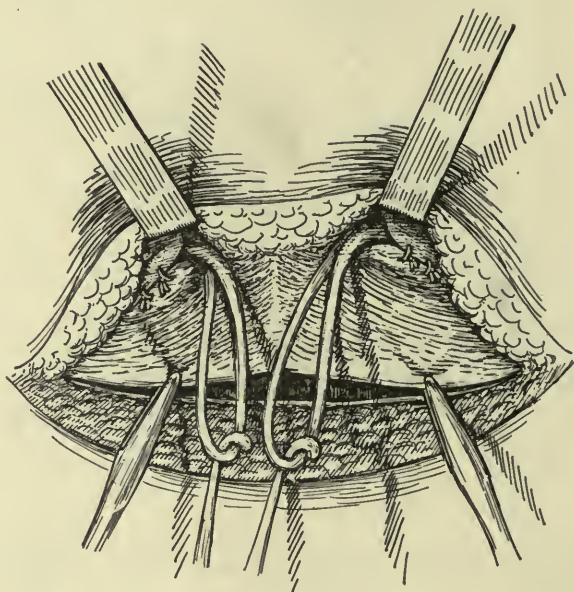


FIG. 13.—ROUND LIGAMENTS WITHDRAWN AND SUTURED TO THE PILLARS OF THE EXTERNAL RINGS.

work that may be necessary accomplished. The condition of the ligaments is noted, i. e., whether they are well developed and free from inflammatory conditions that will prevent their withdrawal from the inguinal canal. Before closing the peritoneum the lower edge of the divided abdominal fascia is grasped with Kocher's forceps and the fascia placed upon a stretch. The spines of the pubes being located, the superficial fascia is separated by blunt dissection until the external rings are exposed. The round ligaments are then found, withdrawn, and fastened to the pillars of the ring, as in the Alexander operation, the redundant portion is sutured to the deep fascia and the abdominal wound closed. It is interesting to note, where this procedure is followed, the effect of the withdrawal of the ligament upon the whole anterior face of the broad ligament. It is drawn upward and forward, the bladder is elevated and the uterus is maintained in its anterior position. Undoubtedly the shortening

of the ligaments also draws upon some of the muscular fibers that run through the upper portion of the broad ligament and are in close relation with the round ligaments and aid in uterine support. The advantages of this method are the same as in the Alexander operation. The strongest and most muscular portion

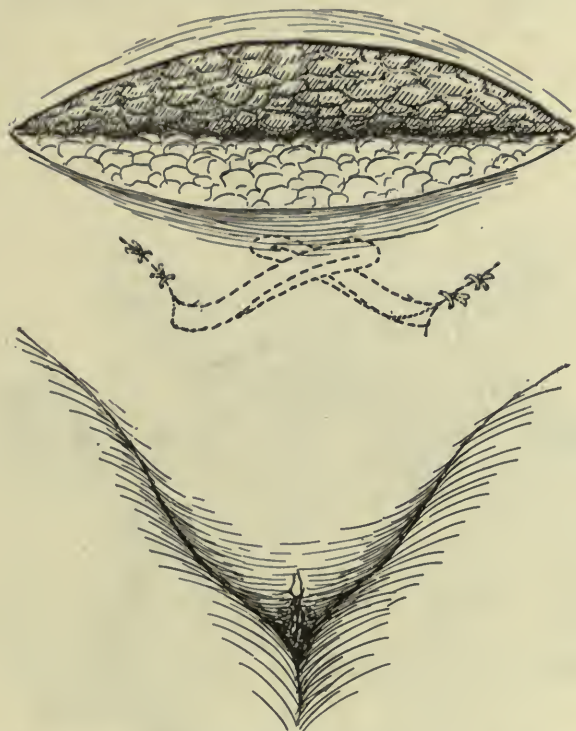


FIG. 14.—LOOPS OF ROUND LIGMENTS CROSSED IN MEDIAN LINE AND SUTURED TO FASCIA.
Abdominal wound ready for closing.

of the broad ligaments is used for supporting the uterus. No newly formed bands of adhesions are left inside the abdominal cavity to cause future complication and there is no interference with subsequent pregnancy or labor.

INTRA-ABDOMINAL AND RETROPERITONEAL SHORTENING OF THE ROUND LIGAMENTS

In cases in which intra-abdominal adhesions or disease of the adnexa form serious complications, or are the chief cause of displacements of the uterus, or the condition of the ligaments is such that attempts to withdraw them from the inguinal canal are inadvisable, the procedure devised by Simpson gives excellent results. Using either the Pfannenstiell or the longitudinal incision through the abdominal wall the necessary intra-abdominal work is completed. The left round ligament is grasped with the hemostatic forceps about an inch and a half from the uterus. The abdominal wall on this side is then elevated by a

retractor and with a second forceps the peritoneum is grasped at the internal abdominal ring on that side and the retractor is withdrawn (Fig. 15). If a median incision has been used the skin and superficial fascia are retracted on the line drawn midway between the anterior superior spine and the spine of the pubis or a little above the level of the internal abdominal ring and the fascia

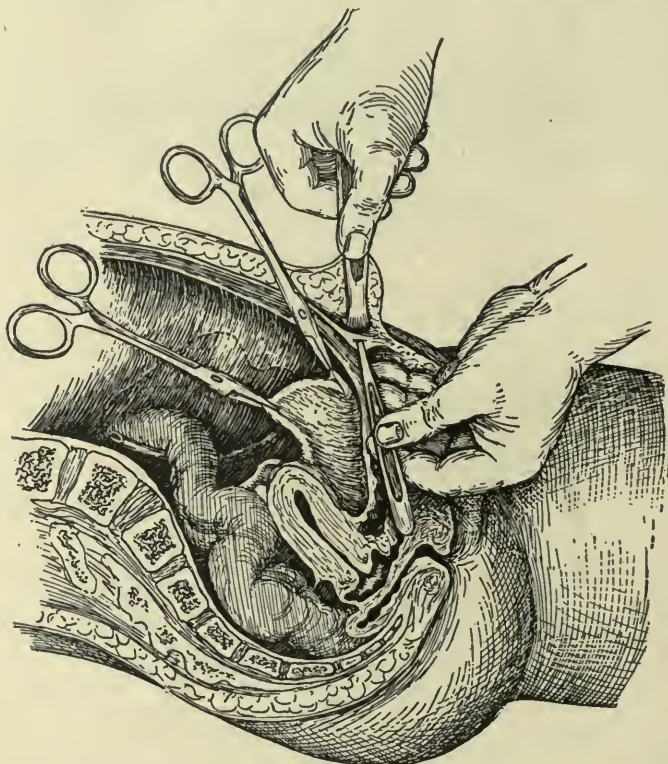


FIG. 15.—HEMOSTAT GRASPING ROUND LIGAMENT $1\frac{1}{2}$ IN. FROM UTERUS. Hemostat grasping peritoneum at internal ring. Tissue forceps holding edges of fascia and retractor elevating the superficial fascia. (After Simpson.)

exposed about $1\frac{1}{2}$ to 2 in. from the median line. Through a nick in the fascia at this point a full curved forceps, such as the one designed by Barrett for the purpose (Fig. 16), is plunged through the rectus muscle in the direction of the forceps, attached to the peritoneum at the internal abdominal ring, passes beneath the peritoneum and enters the broad ligament at the internal ring, close to the round ligament, emerging from the peritoneum at the forceps attached to the round ligament. The round ligament is then lifted by tissue forceps and placed within the grasp of the penetrating forceps, or it may be encircled by a ligature and the ends of the ligature grasped by the penetrating forceps and the forceps then withdrawn, the edge of the peritoneum at the point of withdrawal being held by a hemostat. The round ligament is thus drawn behind the peritoneum and, emerging at the opening in the fascia, is fastened to the under surface of the fascia by chromic gut or linen suture, the suture being placed in such

a way that the ligament is not only held in apposition to the under surface of the fascia but the opening in the fascia is closed at the same time, thus avoiding possible herniæ by weakening the fascia (Fig. 17). The round ligament on the right side is then withdrawn and fastened in the same manner and the abdominal wound closed. Where a Pfannenstiël incision is used, the penetrating for-

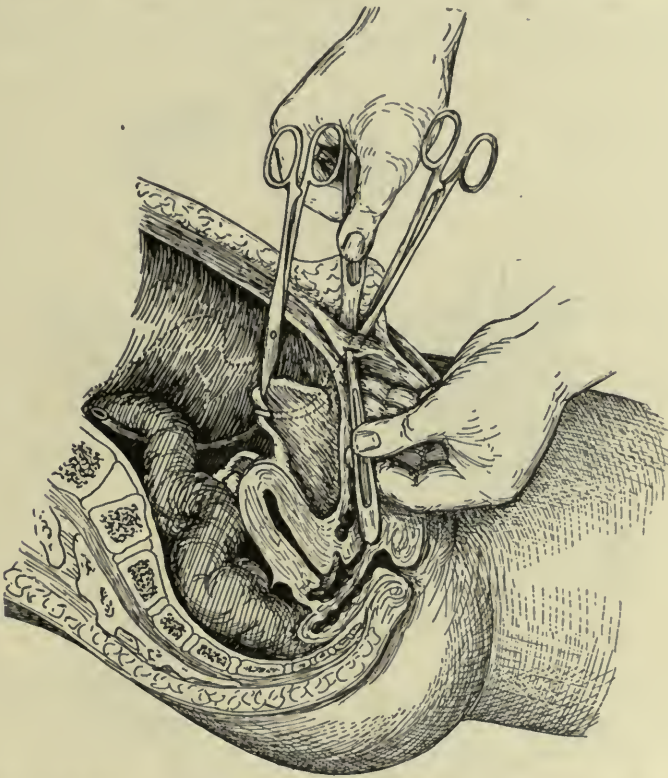


FIG. 16.—CURVED PENETRATING FORCEPS PUSHED THROUGH FASCIA BEHIND PERITONEUM AND BETWEEN FOLDS OF BROAD LIGAMENT. Forceps at internal ring removed. End of forceps seen, grasping the round ligament, at point held by hemostat. (After Simpson.)

ceps is pushed through the outer edge of the muscle and the ligament, when it is withdrawn, is sutured to the under surface of the lower portion of the divided abdominal fascia.

This operation utilizes the strong uterine end of the ligament for support and throws the attachment of the ligaments forward, thus drawing the fundus forward and upward, and is especially useful in relieving the moderate prolapse of the uterus that may exist in some cases. The abdominal cavity is left free of any bands or openings that may be the cause of future obstruction. Simpson reports the perfect anatomical results in 97 per cent. of the cases operated upon by this method, with no reported cases of interference with subsequent labor.

Where time is an important factor in the operation and if for any reason

the exposure necessary to perform the extraperitoneal shortening of the round ligaments is difficult, the method described by Gilliam accomplishes much the same result.

GILLIAM'S OPERATION

The fascia is exposed and punctured in the same location as for extraperitoneal shortening but the forceps is plunged directly through the muscles and peritoneum, and the round ligament grasped about an inch and a half from



FIG. 17.—ROUND LIGAMENT WITHDRAWN AND SUTURED TO UNDER SURFACE OF FASCIA. Method of suture that holds the ligament and closes the opening in the fascia shown in small figures. (After Simpson.)

the uterus and the ligament together with its peritoneal covering is drawn directly across the peritoneal cavity through the parietal peritoneum and the muscle and fascia and fastened to the under surface of the fascia by catgut or linen suture. If a Pfannenstiël incision is used the forceps is plunged through the muscle, the ligament withdrawn and fastened to the under surface of the lower portion of the divided fascia. Care must be exercised in this operation to avoid drawing small pieces of omentum through the peritoneal opening along with the ligament. Several cases are recorded in which this accident has happened, resulting in small herniæ that necessitated subsequent operation. Care should also be exercised not to get the incision in the fascia too high above the pubes. If this is done the ligament is placed under too much tension, often causing discomfort,

and the fundus of the uterus may fall downward and forward and become attached to the peritoneum of the abdominal wall, making an additional suspensory ligament that may complicate future pregnancies or invite intestinal obstruction. The relations of the tube to the round ligament should also be studied before deciding on the amount of ligament that is to be withdrawn. If the uterine end of the round ligament is in close relation to the uterine end of the tube and the ligament is grasped too near the uterus or is drawn too far forward or too near the median line, it may cause a bend in the tube or permit adhesions of the tube to the anterior abdominal wall. This accident we have seen in two cases in which secondary operation was necessary after the Gilliam operation. The main objection to the operation is the fact that the round ligament is drawn directly across the peritoneal cavity, leaving two openings in the abdominal cavity anterior to the distal portion of the ligament, which may be a cause of future intestinal obstruction. Various methods have been devised for closing these openings, but the time necessary for their accomplishment could in most cases be better used to perform the extraperitoneal method of shortening. This operation is at present a popular one and is easily performed. Large numbers of cases have been reported by various operators with a high percentage of symptomatic and anatomical cures. E. J. Ill reports less than 1 per cent. of failures in over 700 cases. Few cases of interference with either pregnancy or labor have been reported, but a number of cases of obstruction, caused by the bands drawn across the abdominal cavity, are on record.

OTHER OPERATIONS

Ventrosuspension.—Suspension of the uterus by attaching the peritoneum near the fundus to the peritoneum of the anterior abdominal wall above the symphysis is mentioned only to be condemned. The procedure has lost its former popularity and has nothing to recommend it but its ease of accomplishment. The reasons for its abandonment as a means of correcting retrodisplacements are the difficulty in gauging the strength of the adhesions formed by union of the two peritoneal surfaces; the possibility of having fixation of the uterus rather than a suspension take place; the stretching out of the adhesion so that there is a recurrence of the displacement; the danger of the adhesive bands being the cause of intestinal obstruction; its interference with pregnancy and labor, many cases of dystocia and abortion having been reported.

The various methods of intra-abdominal shortening of the round ligaments, as suggested by Wylie, Mann, Polk and others, and the intra-abdominal shortening of the round and broad ligaments as suggested by Coffey, in which the round ligaments are folded upon themselves, the loop of the ligaments being either held together by silk or linen sutures, or fastened to the anterior surface of the uterus, are uncertain in their results. The main criticism of the methods being that the strong muscular uterine end of the ligament is not utilized for support and in several cases which have come under my observation for a recurrence

of the retrodisplacement after one of these methods was employed, this portion of the round ligament was found to be atrophied either from interference with its circulation by the sutures or from disuse owing to its malposition. This infolding the round ligaments, however, is useful in certain cases in which the displacement of the uterus is caused by extensive adhesions to surrounding organs where the round ligaments may be folded over and fastened by sutures so as to cover raw surfaces on the anterior wall of the uterus from which adhesions have been stripped, thus serving the double purpose of holding the uterus forward and possibly preventing the formation of new adhesions that would cause future complications. I have also used this method of folding the round ligaments and attaching them to the anterior surface of the uterus to cover over the wounds of the anterior wall caused by the removal of small fibroids, cases in which the weight and position of the fibroids were undoubtedly a causative factor of the displacement. The attachment of the round ligaments to the posterior surface of the uterus, as suggested by Webster and Baldy, is open to the same objection—i. e., that the distal and weak end of the round ligament is used for support. By this method the posterior surface of the broad ligaments, just below the utero-ovarian ligaments, close to the side walls of the uterus are punctured by a blunt forceps so as not to wound the blood-vessels, and the round ligament seized about an inch and a half from the fundus of the uterus. The ligaments are then drawn through the opening and stitched to the posterior surface of the uterus at about the level of the utero-ovarian ligaments. The round ligaments by this procedure are necessarily stripped of peritoneum, and thus exposed may be a fruitful source of pelvic adhesions. In my hands the operation has not given satisfactory results and in a number of cases, where performed, has caused subsequent pelvic pain.

PROLAPSE OF THE UTERUS

Prolapse of the uterus usually results from partial or complete inability of all its supporting forces either from injury or overstrain to maintain it in its normal position in the pelvis. The intra-abdominal pressure, instead of aiding the other forces in holding the uterus in place, becomes an active agent in causing and increasing the prolapse. In no class of cases is the necessity of proper abdominal support so much in evidence as it is in prolapse of the uterus. The majority of women in whom the condition occurs have flabby and relaxed abdominal walls which demand artificial support. So that badly fitting corsets by their downward pull increase the intra-abdominal pressure and thus cause increased strain on the weakened uterine ligaments and pelvic floor. In all cases of prolapse careful attention should be given to procuring a suitable abdominal bandage or properly fitting corset before attempting to support the prolapse by a pessary or correct it by operative procedure, so that after operation abdominal support will be maintained and so far as pos-

sible the misdirected intra-abdominal pressure corrected. If this is not done, the work of the surgeon may be nullified by failure to remove one of the original causative factors. Many cases of retrodisplacements are associated with some degree of descent of the uterus, and many of the symptoms in these cases are due to this descent, so that a successful correction of the retrodisplacement removes a potential condition for future prolapse. While prolapse of the uterus rarely develops in virgins or nulliparous women, as a result of poorly developed genital organs, associated with long-continued and severe muscular strain, the vast majority of cases occur in multiparæ after the child-bearing age. The onset of the condition is so gradual and many women through carelessness or ignorance become so accustomed to the pelvic discomfort and a slight dribbling of urine after coughing or sneezing, symp-

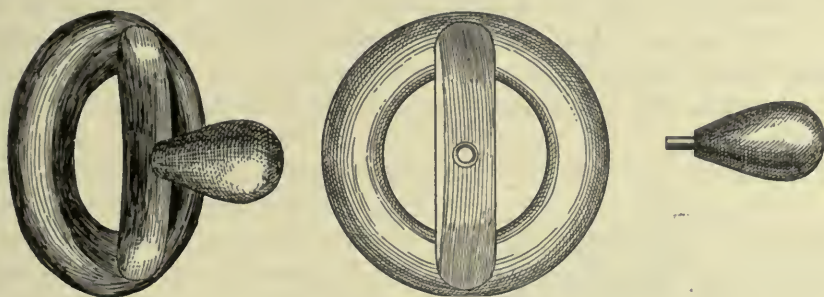


FIG. 18.—MENCE PESSARY. The detachable bar that is put in place after the ring is inserted prevents the displacement of the pessary.

toms that are often associated with the early stages, that the physician is not consulted until the prolapse is well developed or some sudden muscular strain has caused severe vesical symptoms or a marked increase in the protrusion at the vulva. So that every woman who has borne children should be instructed as to the necessity of an examination of the genital organs at least once in two years, and if there is displacement of the uterus or descent either of the anterior or posterior vaginal walls, she should be given the benefit of suitable operative treatment to correct the condition. The importance of such examination increases as the menopause is approached. If such examinations were made at regular intervals the severer forms of prolapse would often be prevented. Choice of operative procedure depends upon the age and condition of the patient and the degree and form of the prolapse. If the patient is still at the child-bearing age, nothing should be done that will complicate future pregnancy or labor unless the prolapse is so severe that this cannot be avoided. Then the facts should be submitted to the patient and her husband and permission obtained to sterilize the woman by such means as are advisable. In women over sixty, or in those whose general condition will not warrant the administration of an anesthetic or extensive operative measures, relief of the symptoms can often be accomplished by some form of pessary. To be successful, however, the laceration of the pelvic floor and subsequent

atrophy must not be so extensive that the lateral tissues of the pelvic floor are incapable of affording support to the pessary. The pessaries that have been most useful in my hands are: (1) The Menge pessary in which the detachable bar that is inserted after the ring is in place prevents its displacement. (2) The Schatz cup pessary of hard rubber, the perforations permitting discharges from the cervix to escape. (3) The inflated soft rubber ring, often the most comfortable to wear but requiring frequent changing because of its liability to collapse, necessitating its reinflation. One of the various forms of cup pessaries that are attached to an abdominal belt may be of service in some cases, but where used must be carefully watched to be sure that no vaginal erosions are produced. Where there is a tendency to expel the pessary a tight perineal bandage fastened to the front and back of the corset or abdominal bandage, will often give the needed support to retain it in place. The pessary should be changed every 3 or 4 weeks and the vagina examined. If erosions develop the pessary should be removed, the prolapse reduced by tampons and the patient kept in the recumbent posture until the erosions are healed.

The forms of prolapse vary from the slight descent of the uterus or

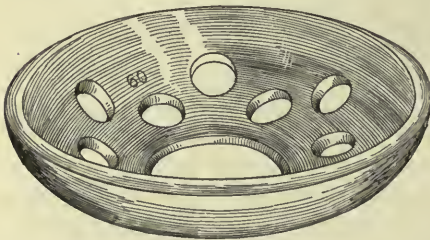


FIG. 19.—SCHATZ PESSARY.

elongation of the supravaginal portion of the cervix with slight prolapse of the anterior or posterior vaginal walls or both, to the complete eversion of the vagina and uterus outside the vulva, the cervix appearing at the lower end of the protrusion and the body of the uterus felt through the vaginal walls below the pelvic outlet. It is not within the scope of this work to dis-

cuss the various forms of prolapse and the readers are referred to the admirable work of Halban and Tandler for a detailed anatomical study of the structures involved. Aside from the discomfort and dragging sensations caused by the descent of the uterus, the most distressing symptoms connected with prolapse are not associated with the uterus itself but with the prolapsed bladder, which is dragged down along with the anterior vaginal wall. The severity of the vesical symptoms increases in proportion to the extent of the prolapse. Hence, the majority of operative procedures have for their object not the replacement of the uterus, but the replacement and support of the bladder. To accomplish this result in many cases little or no attempt is made to restore the injured parts to their normal position, but the structures available for giving support are readjusted, fixed, or transposed by such methods as seem best in the judgment of the operator for the individual case, the uterus itself being sacrificed when necessary. No class of cases places such a tax upon the resources of the gynecologist as is caused by his efforts to relieve a severe and long-standing prolapse of the uterus, and in no class of cases are his best efforts so often rewarded by failure.

CASES OF MODERATE PROLAPSE

In cases of moderate prolapse in women of child-bearing age the uterine ligaments still hold the body of the uterus, often retrodisplaced, well up in the cavity of the pelvis and there is slight protrusion of the anterior and posterior vaginal walls, often with some hypertrophy of the cervix or slight elongation of its supravaginal portion. The majority of these cases will be relieved by the following procedure: curettage of the uterus to relieve the endometritis that usually exists; repair of cervical lacerations by trachelorrhaphy, or by amputation if the cervix is hypertrophied or its supravaginal portion elongated, care being taken not to make the amputation nearer than half an inch from the internal os; repair of the pelvic floor; an external shortening of the round ligaments by Alexander's method, or if intra-abdominal complications exist or are suspected, by the method described on page 408. In these cases the round ligaments are often unusually well developed. Where the prolapse of the anterior vaginal wall and bladder is more extensive, resection of the anterior vaginal wall may be required, and should be performed before the pelvic floor is repaired and the round ligaments are shortened. Care should be taken not to make the resection too extensive or in such manner that the anterior vaginal wall will be shortened. The circular denudation of Stoltz is objectionable for this reason and often fails to accomplish its purpose. The procedure suggested by Hirst will as a rule give adequate support to the bladder and anterior wall. Its aim is to restore the normal support of the vaginal wall by excising the scar tissue at the sides of the vagina behind the symphysis that marks the injuries received during labor. Hirst calls attention to the need of careful investigation and repair of these injuries within 48 hours after labor as a prophylactic measure for the prevention of future prolapse. A triangular denudation is made in the sulci at the sides of the anterior wall behind the urethra, the angles of the denudation being marked by a tenaculum forceps grasping the vaginal wall behind the urethra, another on the anterior vaginal wall opposite, and a third at the inner angle of the sulcus—this triangular area is outlined by a scalpel and denuded of mucous membrane. The edges of the wound are then approximated by interrupted sutures of silkworm-gut passed deeply into the tissues behind the pubis. After the sutures are in place on both sides they should be tightened but not tied until the effect on the prolapse of the vaginal wall is noted. If this procedure gives sufficient support they may be tied and the operation completed; if not, an oval denudation of the anterior vaginal wall can be made in the median line between the sulci and the cervicovaginal junction, the long diameter of the oval extending from before backward. The fascial structures between the vagina and bladder are then brought together by a continuous suture of catgut and the edges of the denudation approximated by interrupted sutures of 20-day chromic catgut. The sutures in the sulci are then tied.

In cases of well-developed prolapse after, or near, the menopause the fore-

going plan of treatment is inadequate. If the uterus has not yet atrophied and the body of the organ is still held within the pelvic cavity the transposition of the bladder to the posterior surface of the uterus and the attachment of the uterus to the anterior vaginal wall, as advocated and practiced by Watkins, is effective and easy of accomplishment. In this class of cases certain preliminary treatment is advisable. The patient should be kept in bed for from 5 to 6 days before operation and the prolapse reduced and kept in place by wool tampons wet with 10 per cent. boroglycerid in glycerin. This tampon should be removed at the end of 24 hours, a copious douche of boric acid at 105° to 110° F. given, and another tampon inserted. If eroded or ulcerated areas exist on the cervix or vaginal walls they should be touched with a 5 to 10 per cent. solution of silver nitrate. The effect of this treatment is to reduce the edema of the tissues of the cervix and vaginal walls that often exists, especially if the prolapse is of long standing, and to render them more suitable for operation and to promote their healing afterward.

If vesical irritation is marked the bladder should be irrigated daily with warm boric acid solution. It is advisable in these cases to obtain a bacteriological culture of the urine as the colon bacillus is not infrequently found and may be a source of infection to the wounded areas after operation. Following this accident to one of my cases I have since given urotropin gr. $7\frac{1}{2}$ t. i. d. and copious draughts of water to all cases for 5 or 6 days before operation and continued it for a week or ten days afterward.

TRANSPOSITION OF THE BLADDER

The vagina and external parts having been sterilized with iodin and alcohol, the anterior lip of the cervix is grasped with tenaculum forceps and pulled outside the vulva, the cervical canal dilated, the uterus curetted. This should always be done and the tissue removed should be submitted to careful pathological examination. Most of these cases are at the cancer age and such examination of the scraping may lead to an early diagnosis of cancer when cure by operative procedure can be expected. Should the report be negative and symptoms of cancer develop later, it gives a fixed date at which it is reasonable to suppose the uterus was not involved. A transverse incision is now made at the cervicovaginal junction and the vaginal edge of the incision is grasped on each side of the median line with Kocher forceps. The anterior vaginal wall is then incised longitudinally in the median line almost to the base of the urethra with a scalpel, or by pushing the blunt point of a Mayo scissors between the anterior vaginal wall and the bladder. The line of cleavage is easily found in this way and by hugging the vaginal wall with the point of the scissors there is little or no danger of injury to the bladder. The forceps at the angles of the two incisions now elevate the flaps of the vaginal wall thus made so that they can be separated from the bladder on either side, the extent of separation depending on the size of the cystocele. With the cervix held downward the

attachment of the bladder to the uterus is located and separated by blunt dissection by pad or scissors, the point of the scissors being directed toward the uterus. This dissection is carried upward until the peritoneal fold is reached. Holding the bladder upward with a narrow retractor, the peritoneal fold is put upon the stretch and can be perforated by blunt forceps or caught with tissue forceps and nicked with scissors, the opening in the peritoneum is enlarged to admit two fingers and the vesical edge of the peritoneum is grasped with forceps and a suture passed through it. This suture is not tied but is left long and is held upon the abdominal drapery by a clamp. The pelvis should now be explored as thoroughly as possible to be sure that there is no obstacle to the delivery of the fundus of the uterus through the peritoneal opening. The forceps attached to the cervix is removed, so as not to interfere with its replacement in the vagina and the anterior wall of the uterus is grasped with tenaculum forceps at the peritoneal attachment. The fundus is now delivered by climbing up the anterior wall with tenaculum forceps or retracting hooks (see Fig. 14 in Chapter IX, Vol. V), under the guidance of the finger, or under the eye, the bladder being held up by a narrow retractor. There is as a rule little difficulty with this part of the technic provided delivery of the uterus is not attempted until the fundus is reached. The vesical fold of peritoneum held by suture may now be attached to the posterior surface of the uterus by one or two catgut sutures and the long retention suture removed. This, however, is not absolutely necessary as the peritoneal fold quickly attaches itself to the peritoneum of the uterus. A 20-day catgut suture is now passed through one flap of the vaginal wall close to the urethral end of the longitudinal incision. It is then passed deeply into the uterine wall just posterior to the fundus and then out through the flap of anterior vaginal wall on the opposite side. This suture fixes the uterus to the anterior vaginal wall beneath the bladder. Care must be taken not to pull the uterus so far forward that it presses upon the urethra enough to interfere with urination. The incision in the anterior wall of the vagina may now be closed. If, however, the cystocele has been large, part of the wall may be excised by removing a wedge-shaped piece from either side of the incision, the narrow base of the wedge being at the cervical end. Enough of the wall should be left to cover the uterus without tension. The closure is accomplished by interrupted catgut sutures, every other one including some of the uterine tissue. The operation is completed by building up a strong pelvic floor. In certain cases additional procedures may be needed for the success of the transposition. If the cervix is elongated so that it interferes with the uterus lying horizontal in the pelvis, when it is drawn forward, it should be amputated. This should be done before the fundus is fastened to the vaginal wall. In some cases where a high amputation of the cervix is necessary additional support of the cervix may be given by Dudley's method of ligating the lower portion of the ligamentum latum colli, excising them close to the uterus and suturing the ends together in front of the cervix beneath the anterior vaginal wall. The attach-

ment of the anterior vaginal wall to the amputated lip of the cervix is completed as the longitudinal incision is closed.

If the body of the uterus is enlarged so that its bulk is too great to be comfortably interposed between the vagina and bladder, a wedge-shaped piece may be excised after it has been delivered from the peritoneal wound and the cut edges brought together by suture and the remaining portion fastened to the anterior vaginal wall. Where this is necessary Watkins recommends the excision of the entire endometrium. In the same way diseased tubes and ovaries can be excised before completing the transposition. If the woman is of the child-bearing age, and this operation is found necessary to relieve the prolapse, she should be sterilized. This is easily accomplished after the delivery of the fundus by resecting the uterine ends of the fallopian tubes. The wounds in the fundus are closed by suture after the resected ends of the tubes are removed and the distal ends covered by peritoneum as recommended by Ries.

In cases where pregnancy is possible and sterilization is not advisable or not permitted, the method devised by Goffe is of service. The preliminary steps of the operation are the same as for transposition, including the opening of the peritoneal cavity. The separation of the bladder, however, must be carried out much further laterally. Goffe extends it far out on the broad ligament. The round ligaments are then exposed and grasped by forceps, folded upon themselves and sutured to the anterior wall of the uterus. The bladder is pushed up and held by three sutures, one to the anterior wall of the uterus just below the fundus and by the others to the anterior surface of the broad ligament below the round ligament. The objections to the operation are its extensive separation of the bladder that may be accompanied by severe bleeding from the uterine veins and the utilization of weak ends of the round ligaments for support. In my own practice I have made a wide separation of the bladder in this class of cases, retaining it in its new position by bringing the fascial tissue beneath the vaginal wall together in the median line and after the longitudinal incision in the anterior vaginal wall is closed, and the pelvic floor repaired, performed an external shortening of the round ligaments by Alexander's method. From my observation of this method of shortening the round ligaments, when it is done with the abdomen opened, I am sure that it pulls the bladder and anterior face of the broad ligaments upward much better than can be done by any method of suture from the vagina.

Where the prolapse is extensive and the uterus is atrophic, vaginal hysterectomy is the operation of choice, the stumps of the uterine ligaments being brought together and interposed between the vagina and bladder. It has been well named by Mayo as "vaginopelvic fixation." The incisions in the vaginal wall are the same as for transposition except that the transverse incision is continued around the cervix and the vaginal attachments at the side and behind the cervix are separated by pad dissection for a short distance. The longitudinal incision in the anterior vaginal wall should not be carried so close to the base of the urethra, but the bladder separation should be carried

as far forward under the anterior vaginal wall. The fundus of the uterus is delivered through the peritoneal opening and the broad ligament is clamped from before backward, first on one side and then the other, and the attachment of the uterus is severed after each clamp is placed. Three clamps on either side are usually sufficient. The first clamp on each side includes the uterine end of the fallopian tubes and round ligaments, or if the tube and ovary are to be removed, the infundibulopelvic ligament and the round ligament. The second clamp grasps the middle portion of the broad ligament. The inner blade of

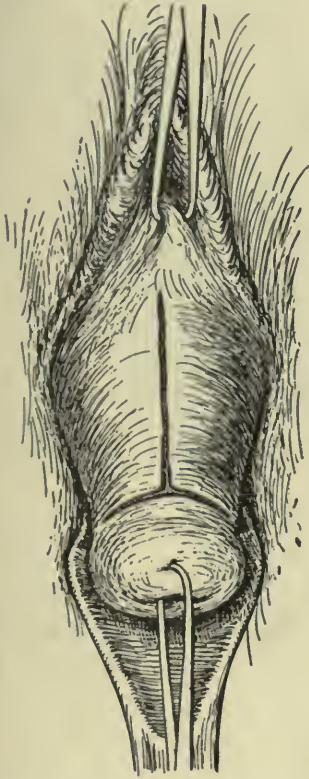


FIG. 20.—TRANSVERSE AND LONGITUDINAL INCISIONS IN ANTERIOR VAGINAL WALL.

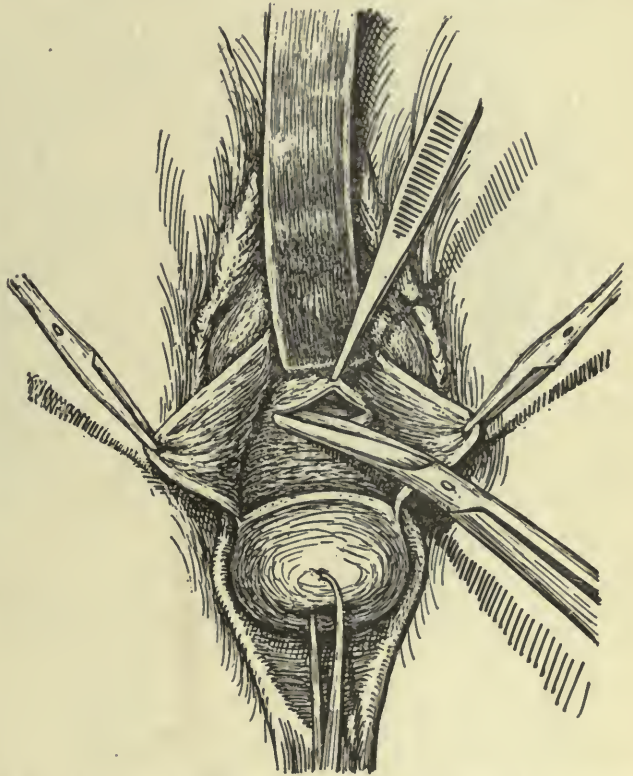


FIG. 21.—BLADDER PUSHED UPWARD AND RETRACTED, INCISION BEING MADE IN THE VESICOPERITONEAL FOLD.

the third clamp is pushed through the peritoneum of Douglas' culdesac, where it is still attached to the edges of the incision on the posterior vaginal wall and grasps the uterine artery and the sacro-uterine ligament and the ligamentum latum colli close to the uterus. After the removal of the uterus the clamps which have been held by an assistant are approximated in the median line and the stumps are brought together by a continuous suture of chromic catgut. The suture is passed behind and close to the lower clamp so that when tied it includes the uterine arteries and the stumps of the sacro-uterine ligament, and the ligamentum latum colli. The lower clamps are then removed. The

suture is now continued mattress fashion, pulling the stumps of the broad ligament together until the upper clamp is reached, when it is passed over and around the tubes (or infundibulopelvic ligament) and round ligament with a double half hitch that controls the ovarian arteries; the suture is then passed through the anterior vaginal wall in the median line just behind the base of

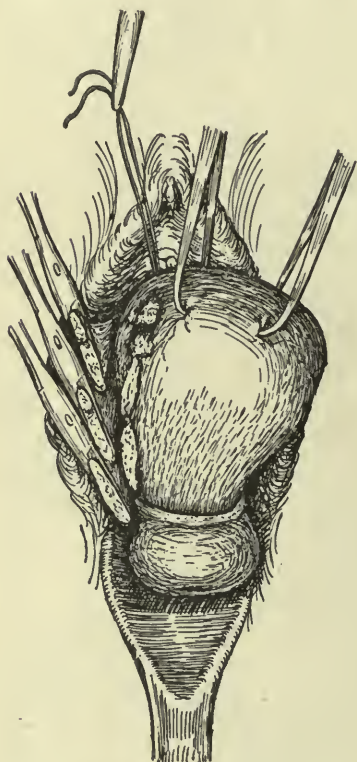


FIG. 22.—UTERUS DELIVERED AND CLAMPS ON RIGHT BROAD LIGAMENT IN PLACE. Suture held by clamp anteriorly is attached to peritoneal fold of bladder.

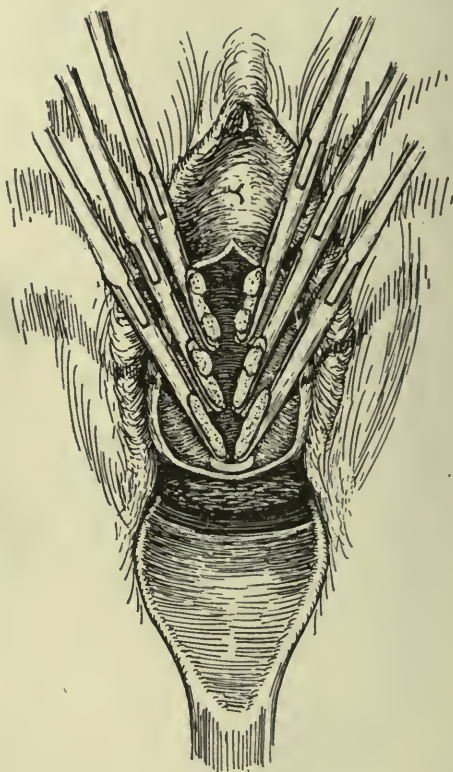


FIG. 23.—UTERUS REMOVED. Clamps on broad ligaments ready to be brought together in median line. Bladder has been pushed upward.

the urethra. This pulls the stump of the broad, round and sacro-uterine ligaments into the pocket anterior to the longitudinal incision and anchors it to the anterior vaginal wall from which the bladder has been separated. The suture is then passed back through the anterior vaginal wall catching the edge of the stump and then emerges through the vaginal wall at the anterior end of the longitudinal incision; the redundant portion of the anterior vaginal wall is removed by excising a wedge-shaped piece from either side of the incision and the incision closed by the same suture, introducing it parallel to the wound about one-eighth to one-quarter of an inch from the edge, first one side and then the other, so that when tightened the surfaces of the vaginal mucous membrane are brought into apposition and the cut edges are in contact with the stump,

thus making a firmer union. The final stitch closes the wound in the posterior vaginal vault. The operation is completed by building up the pelvic floor.

The technic just described is much the same as that advocated by Goffe but makes a stronger attachment of the stump to the vagina than the end-to-end approximation of the broad and round ligaments and thus gives better vesical

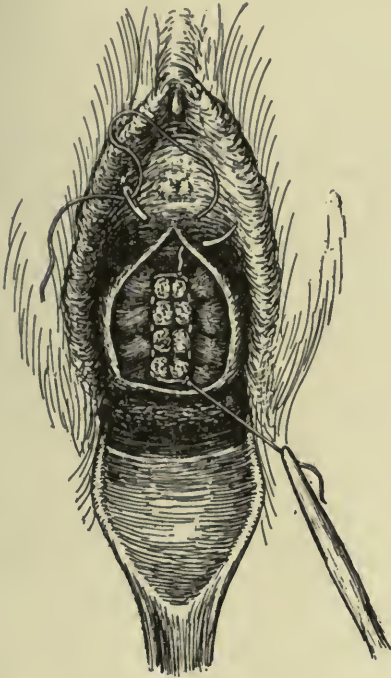


FIG. 24.—BROAD LIGAMENTS SUTURED TOGETHER. Suture passed through the anterior vaginal wall so that the stump will be drawn forward to support the bladder.



FIG. 25.—STUMP DRAWN FORWARD AND EDGES OF INCISION IN VAGINAL WALL DRAWN TOGETHER. Notice suture turns cut edges toward the stump.

support and it is not necessary to fasten the bladder to the round ligaments by suture.

Elderly women stand this operation well and with little or no shock, Goffe reporting a number over 65 years of age in whom it was done without a fatality, and the reports from the Mayo clinic are equally favorable. The after-treatment is much the same as after vaginal hysterectomy, except that for the first 48 hours the bladder should be emptied every 6 hours. If the patient is able to void she should be encouraged to do so, the parts being irrigated afterward with a solution of hydrogen peroxid and sterile water 1 to 4, followed by sterile water. If catheterization is necessary it should be discontinued as soon as possible and, where done, the tip of the catheter should be dipped in a sterile 5 per cent. solution of argyrol before introduction into the bladder. Urotropin should be administered in $7\frac{1}{2}$ grain doses t. i. d. and water should be given

freely by mouth. Should vesical irritation develop, boric acid irrigation of the bladder is of service. Because of the importance of thorough healing of the pelvic floor repair and the advisability of not subjecting it to strain too soon, these patients should be kept in bed for at least 2 weeks.

OTHER OPERATIONS

While the vaginal route is the one of election in the treatment of prolapse, there are many cases in which it cannot be used. Where the prolapse is of long standing and the vaginal mucous membrane and the tissues of the anterior vaginal wall are so thinned and atrophied that plastic work is doomed to failure, or where the prolapse is complicated by intra-abdominal conditions, such as fibroids, ovarian tumors, etc., intra-abdominal methods for supporting the prolapse must be employed. No definite plan of procedure can be outlined for these cases as each one must be considered individually and the strongest tissues available must be utilized for support of the pelvic organs. In all cases where intra-abdominal methods are employed suitable repair of the pelvic floor should be done and amputation of the cervix, when needed, performed before the abdomen is opened.

A brief review of some of the many methods that have been reported and found serviceable will be a guide in undertaking intra-abdominal operations for the correction of prolapse. Where it is necessary to perform supra-vaginal amputation of the uterus or panhysterectomy and there exists only moderate prolapse of the vaginal wall, the stumps of the broad and round ligaments should be firmly sutured to the stump of the cervix or to the vaginal walls. Further support can be obtained if the prolapse is more extensive, by the method suggested by Polk, of dissecting the bladder free from the anterior vaginal wall and plicating the anterior wall of the vagina by deep sutures of chromic gut before fastening the ligaments.

Where after removal of the body of the uterus it is found that the remaining pelvic structures are so elongated that the stump of the cervix can be drawn upward and forward to the anterior abdominal wall, the stump of the cervix may be fastened to the fascia of the anterior abdominal wall by deep sutures of heavy silk or silkworm-gut, as advocated by Baldy, the parietal peritoneum being sutured closely around the cervix before it is drawn between the muscles. This attachment of the cervix to the fascia should be made just above the symphysis at the lower angle of the abdominal wound.

Where the tubes and ovaries are removed leaving the uterus, that organ may be drawn up and fixed to the fascia of the abdominal wall. Many methods have been suggested for accomplishing this fixation. The simplest and most common method is to suture the uterus by chromic gut sutures to the under surface of the abdominal fascia, the parietal peritoneum being sutured to the sides and posterior wall of the uterus. A most radical procedure that may be useful in

selected cases is the exclusion of the fundus from the abdominal wall proposed by Eastman. He reports three successful cases in which, after curettage, amputation of the portio vaginalis and posterior colporrhaphy and perineorrhaphy, the body of the uterus, the tubes and ovaries having been removed, was drawn outside the abdominal wall. All the layers of the abdominal wall were drawn snugly around the uterus and sutured to that organ anteriorly, posteriorly and laterally and the rest of the abdominal wound closed. The fundus was then transfixed with a pin eight inches long, such as devised by Bantock, which does not tend to cut out as do silk or silkworm-gut sutures. The pin is allowed to remain in place two and a half weeks. In these cases the fundus was covered over by skin, growing centrally from the periphery within two or three weeks. Harris suggests the suturing of the peritoneum, muscles and fascia around the uterus and the fixation of the body of the uterus beneath the skin of the abdominal wall. Another modification of this method has been to split the body of the uterus in the median line, the endometrium being excised and the two halves of the uterus fastened on either side to the anterior surface of the fascia of the abdominal wall.

Crile reports an ingenious method of fixation in a case in which two unsuccessful efforts had been made to relieve extreme prolapse, the first operation by plastic work through the vagina and the second by complete abdominal hysterectomy and fixation of the vagina to the uterine ligaments. Crile at the third operation split the peritoneum covering the vagina and found that the prolapsed structures could be pulled forward so that the upper end of the vagina would come in contact with the abdominal wall. He then freed the upper end of the vagina from the surrounding tissue and divided it into two lateral halves by incisions in the anterior and posterior wall, removing the vaginal mucous membrane from the flaps thus made. The ends of the flaps together with the stumps of the broad ligaments were then drawn through incisions in the fascia of the anterior abdominal wall and sutured to its anterior surface, the parietal peritoneum being stitched snugly around the vagina. This patient showed no recurrence of the prolapse at the end of three years.

In the extreme cases of prolapse in which it is not necessary to retain a functional vaginal canal, the suggestion of Edebohls to remove not only the uterus but the entire vagina is sometimes of service. The operation is performed without great difficulty and with comparatively little bleeding. After the vagina and uterus are removed the stumps of the round and broad ligaments are brought together and the vesicoperitoneal fold is sutured to the peritoneum lining Douglas' pouch. The muscles of the pelvic floor are then brought together as high up as possible toward the symphysis and the skin wound closed by deep silkworm-gut sutures.

All of the operations outlined for the treatment of prolapse give promise of success if judiciously employed. No one operation is suited to all cases of prolapse. Each case must be studied by itself and the method of repair selected must be one which utilizes the strongest structures available for the support of

the prolapsed organs. Many of the failures reported are the result of the employment of operative procedures that were not adapted to the individual case.

INVERSION OF THE UTERUS

Inversion of the uterus, occasionally caused by expulsion of intra-uterine tumors attached near the fundus, is usually the result of labor and is fortunately of rare occurrence. If seen immediately it can often be replaced by careful manipulation under strict aseptic precautions. The placenta, if it is attached, should not be removed and manipulations should be directed in the axis of the superior strait of the pelvis. Should manipulation fail and the shock from hemorrhage is not so severe that general anesthesia or operative procedure is contraindicated, the anterior or posterior lip of the cervix, whichever is most accessible, should be grasped by forceps, an incision made in the vaginal wall at the cervicovaginal junction and the tissues connected with the uterus freed. The cervix is incised in the median line until the constricting ring is reached, efforts being made from time to time to replace the uterus, the incision being lengthened until the uterus can be restored to its normal position. The incision in the uterine wall is then closed by a continuous or interrupted catgut suture. If, however, the condition has existed for a length of time and there are evidences of infection of the uterus from exposure or handling, a vaginal hysterectomy should be performed. If there is no infection, efforts should be made to restore the uterus by anterior or posterior hysterotomy. Successful cases of this kind are reported by Crossen and Hirst. If the inversion is due to a tumor of the uterus, the character and location of the growth must govern operative procedure, hysterectomy, or removal of the tumor and replacement of the uterus after hysterotomy being the alternatives.

CHAPTER XV

OBSTETRICAL SURGERY

ROBERT T. FRANK

GENERAL CONSIDERATIONS

Obstetric surgery must, with few exceptions, always remain in the class of emergency operations. The reasons are twofold: first, the date of the onset of labor can never be foretold with exactness; second, the course of an apparently normal labor may at any time change into a complicated one requiring operative intervention. In a well-equipped institution the requisites for operative delivery are always at hand; in private practice they are usually conspicuously wanting. At the present day such lack of preparedness can no longer be excused on any ground, and should lay the physician open to the charge of negligence. Any surgeon who appeared to perform an operation for gangrenous appendicitis, with his sole equipment consisting of a pocket case and half a pound of semi-sterile cotton, would be expelled from the sick room with ignominy; yet every obstetric consultant has at some time been called in to a parturient patient and found the attending physician's armamentarium composed of a scissors, some cord tape, a small basin of lysol, from which the handles of the obstetric forceps conspicuously protruded, a few cotton pledgets, and the copy of a morning paper pressed into service as an obstetric pad. Such conditions are intolerable, and cannot be excused on the score of poverty, smallness of fees or the pressure of economic conditions. They result from the lack of education of both the medical and lay public.

If the conduct of normal labor requires certain preparations and instruments, the successful completion of a complicated operative delivery makes still larger demands in regard to armamentarium, assistance, and skill. The general surgeon, moreover, although perhaps quite competent to perform the major obstetrical operations, will never become a first class "obstetrical surgeon" until he has learned to recognize the exact conditions necessitating intervention, and unless he has studied the peculiar problems which enable him to inaugurate prophylactic measures, to forestall difficulties and yet not to interfere unnecessarily. Otherwise, the already radical and surgical trend of modern obstetrics will pass all bounds of reason, and "meddlesome midwifery" reign supreme.

The anatomy and physiology of the parturient woman, the mechanism of normal and abnormal labor, the causes of dystocia, etc., do not fall into the scope of these pages. Certain fundamental facts, however, require at least passing mention, because upon their recognition depend successful operative measures.

The Normal Pelvis.—As a rule, it is easy to determine that a pelvis is normal. Measurements, by means of a simple pelvimeter, and a careful vaginal examination, demonstrate that fact. A normal pelvis has the following dimensions by external pelvimetry:

Intercristal 28 to 29 cm. (11 to 11 $\frac{3}{5}$ in.) (furthest distance between crests).

Interspinous 25 to 26 cm. (9 $\frac{4}{5}$ to 10 in.) (distance between outer border of anterior superior spines).

External oblique 22 to 23 cm. (8 $\frac{1}{2}$ to 9 in.) (between anterior superior spine of one side and posterior superior of other).

External conjugate 20 to 21 cm. (7 $\frac{4}{5}$ to 8 in.) (from upper edge of symphysis to below spine of last lumbar vertebra).

The Contracted Pelvis.—In those cases in which all the measurements are proportionately diminished, a generally contracted pelvis should be suspected. If the external conjugate falls below 18 or 17 cm. (7 or 6 $\frac{1}{2}$ in.), a contraction of the anteroposterior diameter of the inlet probably exists. If, at the same time, the other diameters have a normal relationship, the pelvis is of the **simple flat** variety; if the interspinous is equal or larger than the intercrystal, of the **flat rachitic type**.

Internal measurements afford a surer guide, and of these the true conjugate (normally 10 cm. or 3 $\frac{9}{10}$ in.) is the most important diameter. A true conjugate below 7 cm. (2 $\frac{4}{5}$ in.) in a flat, and 7.5 cm. (3 in.) in a generally contracted pelvis is considered an absolute bar to the delivery of a child which has reached term. In addition to the measurements of the inlet, the height and inclination of the promontory, deformities of the spinal column, and the configuration of the pelvis play an important rôle. At the outlet, the acuity of the subpubic arch, the distance between the tuberosities of the ischia, and, above all, the posterior sagittal diameter are necessary in order to estimate the probable course of a given delivery.

Examination in Pregnancy.—All of these points can be readily determined at the first examination of the gravid woman, which should always be made in the early weeks (sixth to eighth) of pregnancy. At this thorough routine examination, other abnormalities, such as those of the soft parts (congenital septa, vaginal or cervical scars, obstructing tumors—ovarian cysts, cervical fibroids) or of the pelvic bones (such as enchondroses or oblique contraction) cannot fail to be discovered, and appropriate measures for their treatment, either during the course of pregnancy or during labor, can be instituted. The general condition also plays an important rôle in parturition. Severe heart lesions, diabetes, tuberculosis, or other systemic diseases may require termination of pregnancy.

Therapeutic abortion, to be of value, must be induced in the early months, and, therefore, abnormalities should be determined early in pregnancy.

Moderate and Slight Degrees of Contracture.—Normal pelves, on the one hand, and extreme degrees of contracture, on the other, can be recognized with ease even by the tyro. Difficulty arises mainly in the intermediate group of cases, which embrace flat pelves with a true conjugate of between 9 and 7.5 cm. ($3\frac{1}{2}$ and 3 in.) and generally contracted pelvis with true conjugate of 9.5 to 8 cm. ($3\frac{7}{10}$ to $3\frac{1}{10}$ in.).

The Test of Labor.—In dealing with such a flat or contracted pelvis in a primigravida, it may be necessary to subject the patient to the "test of labor." Early in the second stage an examination is made to determine whether the head is engaging and moulding. If disproportion is apparent, the labor may have to be terminated by cesarean section (*vide infra*). Induction of labor before full term may be indicated, should disproportion of the fetal head to the maternal pelvis develop. This can be determined with some degree of certainty by testing the impressibility of the head into the true pelvis at weekly examinations performed from the thirty-fourth week on. These are the cases which demand judgment and experience.

Even after labor has been in progress for hours and continued lack of progress shows that the obstetrician's judgment was at fault, and that version or forceps are contra-indicated, such cases can yet be brought to a happy termination by one of the major operations (hebstomy, cesarean section) if the fetus is in good condition, the asepsis perfect and vaginal examination infrequent. Unfortunately in the great majority of instances, these conditions do not obtain; the attending physician has not abstained from examination, his aseptic technic has been faulty, and very probably futile attempts at the application of forceps, in spite of an only partly dilated cervix, have been made. The consultant is then reluctantly obliged to perform embryotomy on the still living child in the interest of the mother, because the danger of sepsis is too great to permit cesarean section.

In the class of cases demanding therapeutic abortion in the early months, or in those cases of pelvic contracture requiring induction of premature labor, cesarean section, etc., operative intervention should not be delayed until it becomes an emergency operation, if proper care has been exercised. Nevertheless, because of lack of knowledge, forethought, or omission of early examination, the necessity for such interventions are most commonly not recognized until the eleventh hour. On the other hand, unforeseeable complications, such as eclampsia, placenta prævia, malpositions, etc., may arise at any time, necessitating immediate action.

Dystocia vs. Inertia.—It is essential for the accoucheur to be familiar with the course of normal labor; then all deviations from the normal will be promptly recognized. The most common error made by the inexperienced physician is to mistake a slow labor for a dystotic one. He, thereupon, attempts to apply forceps to a head just engaging at the brim, perhaps through an undilated cervix,

thus destroying fetal life in most instances, by compression, and seriously damaging the maternal soft parts. Or he may disturb a breech presentation by early and uncalled-for traction, cause extension of the arms, and, thereby, risk losing the child.

On the other hand, the mistaken patience and stoical endurance displayed by some attendants, who will sit by the bedside and calmly watch the uterus try to overcome an undeliverable presentation or absolute dystocia, until uterine rupture is imminent or does occur, is sometimes equally marvelous. That this accident is not more frequent is, after all, to be ascribed mainly to the efficiency of nature.

Differences between Obstetric Operations and Those of General Surgery.

—Because the problems of obstetric surgery differ in so many ways from those of general surgery, and because the practice of this art so often falls to the non-specialist, I have taken occasion to point out some of the common sins of omission and commission, with the hope of emphasizing the fact that “meddlesome midwifery” is as dangerous as careless “*laissez aller*.” For the same reason, I deem it wise to refer to many details well known to the specialist in this branch.

As has been previously stated, obstetric operations must be classed as emergency operations. Usually the operation will have to be performed at the patient’s home, sometimes under most unfavorable conditions and in the most squalid surroundings. In what is to follow, it will be taken for granted that proper assistance, proper instrumentarium, and proper aseptic conditions are to be provided. These primary requisites can be obtained everywhere at a comparatively small outlay of money, but they do demand a large expenditure of forethought and care. In cities, public or private institutions are to be preferred when major operations are unavoidable. In hospitals, the appliances, technic, and assistance differ but slightly from those employed in other surgical work. Where proper surroundings are not available, or where the operator lacks skill and experience, it may become necessary to substitute a simpler, though destructive operation, such as craniotomy, for cesarean section, which makes greater technical demands and requires better surroundings.

In order to cope successfully with all complications likely to be encountered, the obstetrician requires a fairly extensive outfit.

INSTRUMENTS AND ACCESSORIES

Consultant’s Obstetric Bag.—A well equipped obstetric bag contains at least the following articles, varying somewhat with the individual wants of the consulting obstetrician. These articles are readily packed in a dress-suit case of 24 in. by 16 in. by 6½ in. dimensions.

1 copper sterilizer 18 in. by 6 in. by 4 in.

1 short obstetric forceps (fenestrated blades, Simpson or Vienna).

- 1 axis traction forceps, Lobenstine's modification of Tarnier's model.
- 1 Smellie perforator.
- 1 Braun cranioclast.
- 1 Braun decapitating hook.
- 1 solid blade forceps with pelvic curve (McLane-Tucker).
- 1 Auvard's three-bladed cranioclast.

} Optional.

REGULAR SET (instruments to be sterilized at every normal labor):

- 1 curved scissors, blunt-pointed.
- 1 straight scissors, blunt-pointed.
- 1 mouse-tooth forceps.
- 1 anatomical forceps.
- 1 curved uterine dressing forceps.
- 3 hysterectomy clamps (8 in.).
- 2 ovarian clamps.
- 4 Pean artery forceps.
- 2 volsellum forceps.
- 1 needle holder (either curved, seissor-handled Hegar's, or modified Mathieu's).
- 1½ dozen needles (3 round bodies ½-circle No. 4; 6 Martin's fine No. 5; 3 Martin's fine No. 4; 3 ½-circle surgical No. 18; 3 ½-circle No. 12).
- 1 Chamberlain glass uterine drainage tube with rubber tube attached (for intra-uterine irrigation).

PACKING SET (For packing uterus, repairing cervix, etc., sterilized for every confinement):

- 2 vaginal spatulæ (Segond's or Brettauer's obstetric spades, Fig. 4).
- 2 volsellum forceps.
- 2 ovarian clamps.
- 1 uterine sound.
- 1 large dull curet.

HYPODERMIC SET IN METAL CASE:

- 1 Luer all glass syringe, 15 minims (6 hypodermic needles).
- 1 tube ¼ gr. morphin hypo tablets.
- 1 tube 1/30 gr. strychnin sulphate.
- 1 tube 1/100 gr. nitroglycerin.
- 1 tube 1/100 gr. atropin sulphate.

DRUGS AND ACCESSORIES:

- 1 dozen ampules aseptic ergot.
- 1 dozen ampules pituitrin.
- ½ dozen ampules camphor in oil.
- Biehlorid tablets (*colored*).
- 50 c. c. chloroform.
- 100 c. c. ether.
- 8 oz. tincture of green soap.
- Esmarch chloroform mask.
- Screw and mouth gag (Denhart's or Heister's).
- Esmarch drop bottle.
- 2-qt. fountain syringe (red rubber) or a sterilizable douche can with tubing.
- 1 rubber apron.
- 1 leg holder (Clover's crutch) or linen sling.
- 1 binaural stethoscope.

2 hand brushes.

2 drams argyrol 20 per cent. (This solution must not be kept longer than 1 week, otherwise it produces irritation.)

INFUSION SET IN METAL CASE:

1 Esmarch infusion needle for intravenous infusion.

1 large aspirating needle for subcutaneous infusion.

1 scalpel.

1 tube No. 1 plain catgut.

1 rubber connecting tube with glass connections.

1 bottle sterilized salt (added to 1 qt. of water forms normal salt solution).

$\frac{1}{4}$ in. rubber tubing 16 in. long for tourniquet.

SUPPLIES:

1 sterilized gown in wrapper (long-sleeved).

3 pairs of sterile rubber gloves, in separate wrappers.

5 yd. 5 per cent. iodoform gauze.

3 packages 1-yd. plain gauze.

6 tubes No. 2 10-day chromic catgut.

3 tubes No. 1 10-day chromic catgut.

3 tubes No. 1 plain catgut.

3 tubes No. 0 plain catgut.

3 tubes med. silk-worm-gut (black).

2 envelopes sterile cord tape.

3 rubber catheters (Nos. 12, 14; No. 4 English for newborn).

2 woven tracheal catheters (Nos. 14 and 15).

3 glass female catheters.

3 glass connecting tips (to connect with tubing for fountain syringe, bags, etc.).

1 pelvimeter, Collyer's.

1 set of Voorhees bags Nos. 1 to 4; and extra size holding 500 c. c. (for placenta prævia).

150 c. c. Janet-Frank glass syringe.

Heavy tape for tying off bag.

Portable electric light with shade, 12 ft. conducting cord, and plug.

Razor for shaving operative field.

This outfit suffices for all obstetric operations except abdominal cesarean section and hebstostomy. It does not include the special instruments required for curettage. The sterile towels, sponges, and basins required are usually obtained from the patient.

Supplies Not Carried in the Bag.—**TOWELS.**—Towels are preferably of thin material (dish towels or new diapers, 17 in. by 26 to 28 in.) wrapped 6 in a package, with thick cotton-flannel covers, and dry sterilized. If this is impossible, they may be sterilized in steam above the instruments, or may be freshly boiled before using, and employed wet. One dozen towels suffice for ordinary operative work. (It is wise to have all washable goods carried by the physician stamped with the physician's name in indelible ink.)

SPONGES.—For sponges sterile absorbent cotton, twisted into separate pledgets and freshly boiled, is useful in all perineal work. For laparotomies folded gauze sponges should be employed.

BASINS.—Basins need rarely be carried along, as household utensils (agate

ware) can be used. Hot and cold sterile water is best prepared in a tea-kettle, the spout of which has been plugged with cotton (boil 15 to 30 minutes).

The following articles are absolutely necessary in order to conduct a confinement properly, and to be used during the puerperium:

- 3 dozen sterile vulvar pads.
- Rubber sheeting or oil cloth about 36 by 54 in.
- 5 yd. sterile gauze.

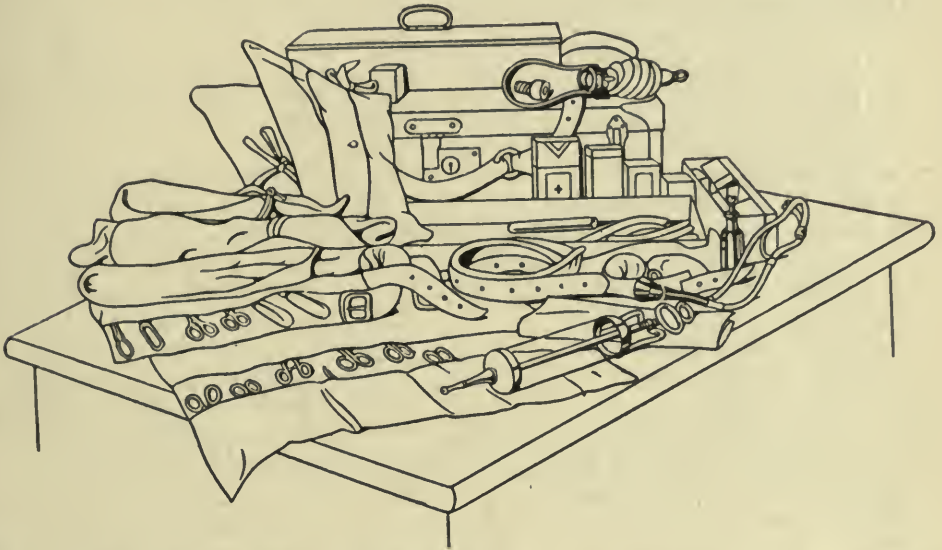


FIG. 1.—THE OBSTETRIC OUTFIT. The dress suit case with its contents is shown. These include sterilizer; 3 packages, containing 2 pairs of forceps and the craniotomy set (on left); gown and gloves (above on left). Below the "regular" and "packing" set are spread out. The numerous accessories enumerated in the list are shown.

- 1 lb. sterile absorbent cotton.
- 1 bed pan.
- 1 enema bag.
- 2 or 3 cheap agate or china basins.
- 1 2-qt. agate or china pitcher.

These articles can be bought by the poorest patient and kept ready for use.

In addition the patient (or if not, the physician) should have on hand

2 dozen sterile towels (put up 6 in a package).

1 dram of argyrol 20 per cent.

1 package of cord tape.

1 eye dropper.

2 hand brushes.

$\frac{1}{2}$ oz. fluid extract of ergot.

8 oz. tincture of green soap.

My patients are instructed to have the following supplies on hand. They cost approximately \$16.00, and are purchased by people of even moderate means.

2 sterilized bed pads (36 in. square).

- 3 dozen sterilized vulvar pads.
- 2 sterilized muslin binders.
- 2 dozen sterilized 4 by 4 in. gauze sponges.
- 5 yd. sterilized gauze.
- 1 dozen sterilized umbilical dressings.
- 5 yd. jar iodoform gauze 5 per cent.
- 1 yd. jar plain sterilized gauze.
- 1 lb. sterilized absorbent cotton, in $\frac{1}{2}$ lb. packages.
- 1 package sterilized tape for cord.
- 1 rubber sheet 36 by 54 in., sterilized.
- 1 rubber sheet 36 by 36 in., sterilized.
- 1 fountain syringe, sterilized.
- 1 rubber catheter, sterilized.
- 1 agate douche pan, sterilized.
- 4 agate basins, sterilized.
- 1 glass douche nozzle, sterilized.
- 1 eye dropper, sterilized.
- 2 nail brushes, sterilized.
- 2 tubes white vaselin, sterilized.
- 1 bath thermometer.
- 4 dozen safety pins (large and small).
- 2 oz. boric acid, powdered.
- $\frac{1}{2}$ oz. Squibb's fluid ext. ergot.
- 100 gm. Squibb's chloroform.
- 8 oz. tincture green soap.
- 25 bichlorid tablets.
- 16 oz. alcohol 95 per cent.
- 1 dram argyrol sol. 20 per cent.
- 1 box Squibb's talcum powder.
- Lime.
- Soda.

Laparotomy Set.—The outfit for major abdominal operations consists of an ordinary laparotomy set, which is readily housed in a smaller dress-suit case. Combined with the contents of the obstetric bag, the following is ample:

- 3 scalpels.
- 2 Volkmann's abdominal retractors.
- 1 large Fritsch abdominal retractor.
- 8 Péan artery forceps.
- 3 Ochsner forceps, 8 in.
- 5 Jacobson's hysterectomy clamps, 8 in.
- 2 volsellum forceps.
- 6 sponge holders (Foerster's ring pattern).
- 2 ovarian clamps.
- 2 needle holders (curved scissor-handled Hegar's for deep pelvic work, Gerster's for superficial suturing).
- 1 dozen needles.
- 1 uterine dressing forceps, straight.
- 4 scissors—2 straight, 2 curved (1 long, 1 short).
- 4 oz. tincture of iodine for sterilizing the abdomen.
- 1 dozen tubes No. 2 10-day chromic gut.
- 3 tubes No. 3 silk.

- 3 tubes No. 2 plain catgut.
- 3 tubes No. 1 plain catgut.
- 3 tubes No. 0 plain catgut.
- 3 pair dry sterile gloves in separate wrappers.
- 1 dozen dry sterile towels.
- 1 dry sterile laparotomy sheet.
- 2 packages dry sterile gauze sponges.
- 6 dry sterile laparotomy pads.
- 3 dry sterile gowns (long-sleeved).
- 3 dry sterile caps.

Hebosteotomy Set.—For pubiotomy the following special instruments are added:

- 3 Gigli saws.
- 2 handles for saw.
- 1 pubiotomy needle (Doederlein's).
- 2 blunt retractors (Ferguson's double-ended).

Curettage Set.—For curettage the following instruments are needed. Most of them are contained in the other sets.

- | | |
|--|----------------------|
| 2 vaginal spatulæ (or Graves operating speculum). | } From ordinary set. |
| 2 volsellum forceps. | |
| 2 ovarian clamps. | |
| 1 uterine sound. | |
| 1 large dull curet. | |
| 2 smaller sharp curets. | |
| 1 Goodell cervical dilator. | |
| 1 small intra-uterine irrigator (or a glass catheter will do). | |
| 1 intra-uterine dressing forceps. | } From ordinary set. |
| 1 straight scissors. | |

The contents of the obstetric and laparotomy bags just enumerated suffice for all operative measures required in obstetric surgery. The instruments and supplies contained in them supplement each other. Both bags should always be ready for instant use, and after having been employed, should at once be prepared again. The general practitioner who does not intend to, or is unable to cope with more than the simpler complications, or who is so situated that he can call upon a consultant for assistance, does not require such a complete outfit.

Obstetric Bag for General Practitioner.

- "Regular" set.
- "Packing" set.
- Vicuna or Simpson forceps.
- "Hypodermic" set.
- Catgut and sterile supplies (gown, gloves, gauze, catheters, drugs).
- Towels and cotton if not provided by patient.

EXAMINATION OF THE PATIENT

When called to see a woman during her pregnancy, labor, or puerperium, the most pressing duty is to determine at once the condition of the patient and to make an exact diagnosis, in order that the proper intervention can be practiced. The obstetrician, especially the consulting obstetrician, must take noth-

ing for granted. If he does, he will overlook essential facts in the history. Furthermore, unless he regularly makes a thorough routine physical examination, he will be sure to miss vitally important factors. After the consultant has heard the history from the attending physician, he should try to confirm and amplify the data by questioning the patient herself. The physician, in all probability, will also volunteer his conception of the state of affairs, but the consultant must, nevertheless, determine every point to his own satisfaction. With tact and discretion no offence will be given.

History.—These facts in the history are most essential: the number and character of previous pregnancies and labors, the duration of the present pregnancy, symptoms that have arisen in its course, and the present complaints. If the patient is in labor, the frequency and character of the pains, the intactness, or time of rupture of the membranes, and the number of examinations, or variety of interferences already practiced, must be elicited. Immediately post partum, the nature and duration of the labor, the intactness of the placenta and method of its delivery are ascertained as a matter of course. Then those special symptoms for which the consultant has been called in are inquired into, as, for example, the time of onset of shock, amount of hemorrhage, etc. During the puerperium these same questions are asked. In addition the temperature chart is of especial significance.

External Examination.—Next the obstetrician should rapidly but carefully examine the patient, ascertaining her general condition and appearance, degree of anemia, pulse-rate and volume, respirations and temperature. It is well to listen to the heart, and often also to the lungs, and to take the temperature and pulse-rate. By external abdominal examination the size of the uterus, an over-distended bladder, position of the fetus, its heart sounds, the frequency and character of the pains, abnormal tenderness, a high contraction ring, tetanus uteri, etc., are elicited. Unless pelvimetry has previously been practiced, measurements are taken in dystocia.

Internal Examination.—Thereupon the patient's genitals are disinfected, as described under preparation of the patient, the obstetrician scrubs up, draws on sterile gloves, and makes his pelvic examination. It may be well to have the patient turned across the bed, to facilitate thorough examination. At this examination the essential facts are determined, varying somewhat with the period of gestation or stage of labor. The size of the introitus and outlet, the configuration of the pelvis, the condition and dilatation of the cervix, the presenting part, the position, degree of flexion and of moulding, descent, etc., are ascertained before delivery. Moreover, injuries already sustained by interference or those spontaneously acquired are noted. Finally the internal conjugate is measured (Fig. 2). By following out this definite routine considerable expertness is readily acquired, and the "touch picture" is automatically visualized. The obstetrician must learn to reconstruct the position of the fetus in his mind's eye.

Emergencies.—Under certain very exceptional conditions, complete ex-

amination and complete preparations have to be omitted. Such instances are, for example, eclamptic convulsions, in the presence of which our first efforts on arriving should be directed to protect the tongue and to control the seizure, by morphin or anesthesia; or a post-partum hemorrhage, where the attending physician has already gone away and all the appliances used during labor have

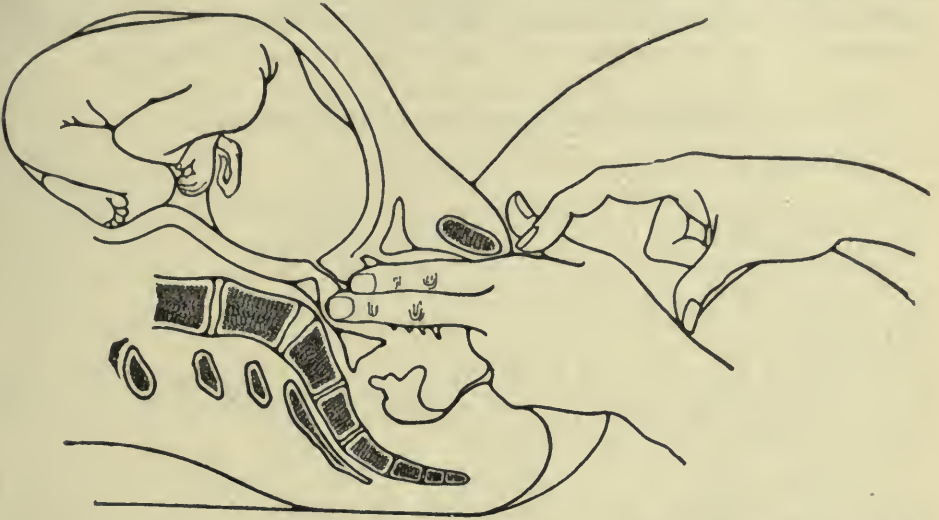


FIG. 2.—MEASUREMENT OF THE DIAGONAL CONJUGATE IN A CONTRACTED PELVIS. The middle finger of the internal hand touches the promontory. The distance to the lower border of the symphysis is marked by the index finger of the outside hand. The examining hand is withdrawn and the distance is then measured with a pelvimeter or rule. One to $2\frac{1}{2}$ cm. are deducted depending upon the height and inclination of the symphysis. The resultant is approximately equal to the true conjugate.

been removed. Here emergency measures which tax self-control, inventiveness, and experience are called for.

Not until the examination is completed, is the obstetrician either in a position to determine the method of procedure or ready to map out his plan of action. He has brought with him his instruments and his sterile supplies; but if the further conduct of the case is to be concluded at the home, he will require assistance and proper aseptic surroundings.

ASSISTANTS

An anesthetist is needed for all operations except such minor ones as packing the cervix, introducing a bag or bougie, primary perineorrhaphy.

A trained nurse is essential at all operative interventions, even if it is impossible for the patient to retain her services after labor is completed.

One or more medical assistants are required at every laparotomy. An additional skilled assistant may, at times, mean the difference between life and death to mother or child, when dealing with placenta prævia, asphyxia, or other difficulties not requiring laparotomy. Not infrequently 3 or 4 enthusiastic younger practitioners band together, agree to assist and supplement each other's

work in charity or poor cases, and thus are able to work under the best conditions with a minimum of outlay.

The substitution for such trained help by members of the household or obliging neighbors is permissible only where it might be permissible for a trained surgeon to call upon the aid of the relatives in dealing with a strangulated hernia, ruptured intestine, or bleeding vessel. This policy is rarely, if ever, employed by the surgeon, but is of daily occurrence in obstetrics, and if this art is eventually to be elevated to a proper standard, such false economy must be eliminated.

PREPARATION FOR SURGICAL INTERVENTION

Preparation of the Patient.—If the patient has not been previously prepared, the nurse should at once prepare her. After the onset of labor a local toilet only can be given. It is safer, even during the last weeks of pregnancy, to interdict full baths and limit the gravida to shower baths. This will obviate the possibility of bath-water entering within the vulva and contaminating the birth passages.

When labor has set in, the vulva and anal region should at once be shaven (not merely clipping the hair). For hebstectomy and abdominal section the pubes and abdomen also require shaving.

Unless the bowels have thoroughly moved within 12 hours, a low soap-suds enema should be given at any time before the second stage has begun. Patients, after rupture of the membranes, must never be permitted to use the toilet. Both urination and defecation should be performed on the bedpan and scrupulous care of the perineum should be observed (irrigated off, sterile pad worn).

Immediately preceding all operative intervention, the bladder must be emptied with a catheter. This is especially important before applying forceps, performing version, hebstectomy, or abdominal operations. Before labor pains have set in, a glass female catheter proves most aseptic; during labor only rubber catheters are allowed; post partum, glass catheters are again given preference.

Patients in active labor usually refuse solid food; therefore, solid stomach contents will rarely interfere with the giving of an anesthetic.

Preparation of Operating-room.—The bed is utterly unsuited for operative work. At the most, in an emergency, the uterus may be packed with the patient laid across the bed, or a simple perineorrhaphy performed in this posture.

THE ROOM.—For major work, when possible, an adjoining room is to be chosen. This will prevent the patient from witnessing the preparations. Rugs are removed, carpets protected and unnecessary furniture taken out, but sweeping or raising the dust is to be avoided. For perineal work, in the day time, a large window gives admirable light. At night, if electric light is available, the portable drop light can be arranged to throw its rays over the operator's right shoulder. If this illuminating source is not to be had, gas, lamps, or candles must be pressed into service. For laparotomies an over-head light is needed.

TABLE.—The ubiquitous kitchen table serves all purposes unless Trendelenburg posture is required, which is most exceptional (rupture of uterus, pelvic tumors). The table top is covered with a folded blanket, over which a kitchen oil cloth is laid. For perineal operations the oil cloth is arranged to hang over the table in the form of a Kelly pad draining into a slop pail. The coverings can be secured in place with a few tacks or pins. A small pillow is placed in readiness for the patient's head. The Clover crutch is also made ready.

A piano stool or low kitchen chair affords a seat for the operator. A table to the right of the accoucheur holds the necessary instruments, one to the left, the sterile supplies. The basins with solutions are later grouped near by on kitchen or other chairs.

Sterilization of Instruments, etc.—The "regular and packing set" should be boiled for every confinement. If the instruments are boiled in their covers (15 minutes in 1 per cent. sodium carbonate solution) the accoucheur, when scrubbed up and ready, spreads a sterile towel on the instrument table and merely unrolls the covers upon this. The instruments, their handles projecting, are now readily accessible and require no additional arrangement. The sterilizer is empty and may be employed to boil forceps, craniotomy set, etc., as required, which when ready are added to the usual instrumentarium.

If the patient has not been able to afford the sterile supplies mentioned in the "patient's list," a wash boiler is used. Into this, agate or other basins (3 or 4), a rubber fountain syringe, and 1 to 1½ dozen towels or clean diapers are placed and boiled for 20 minutes. Should the obstetrician not carry dry sterile gloves, he may boil his gloves together with these articles and draw them on wet.

The operator himself, after scrubbing, takes the sterile basins, places them within reach, upon a chair draped with a sterile towel, and has the nurse fill them with sterile water from the tea-kettle. The only solutions used by me are sterile water for washing off the vulva, and a bichlorid solution (1:500) for constantly disinfecting the gloved hands.

The tubes containing ligature material may be boiled with the instruments or may lie for some time (30 minutes) in one of the basins of bichlorid (1:500) submerged by the weight of a sterile towel.

Non-sterile supplies, i. e., towels still in their covers, jars and packages of gauze, package of cord tape, argyrol for the eyes, etc., are ranged on a separate table (or other piece of furniture) designated as the *nurse's table*. A sterilized douche bag or douche can, containing hot sterile water (125° F.) is hung up at a height of 3 ft. above the table, within easy reach of the operator. For irrigation the nurse joins the end of the sterile rubber tube attached to the irrigator (held by the operator) to the glass connecting tip.

The anesthetist arranges either a small table or a chair for his supplies. These consist of an Esmarch mask, chloroform, ether, mouth gags, hypodermic set, and drugs. A few sponges and an ovarian clamp can be obtained from the

operator, if the necessity arises, to remove mucus from the throat or to grasp the tongue.

For all operative deliveries, it is wise to have large basins of cold and hot water in readiness, for resuscitating the asphyctic baby. Aspirating catheters, wipes for the mouth, and hot water bottles should always be on hand.

A complete operating room of this type can be improvised and fully completed in from 30 to 45 minutes. Not until all is prepared may the patient be led or carried into the room and helped onto the table.

Final Preparation of Patient.—For perineal operations, such as introduction of bags (often without anesthesia), forceps, version, etc., the Clover crutch is applied below the knees, the legs secured in the lithotomy position, the buttocks pulled to the edge of the table and the vulva shaved (preferably done before). The vulva, perineum, thighs, and lastly the anal region are thoroughly scrubbed with sterile water and green soap applied with a towel or cotton. The nurse irrigates the surface (using the tea-kettle or the douche bag) and applies a bichlorid towel (1:1,000). Some operators now employ tincture of iodine as the sole disinfecting agent, others conclude the usual disinfection of the vulva by this application. The custom generally prevails to precede operative delivery by a vaginal douche of 1 per cent. lysol solution. Both of these measures, as a routine procedure, appear unnecessary. Where numerous vaginal examinations from suspected sources have been made, or a suspicious vaginal discharge exists, we give a douche of hot sterile water (2 to 4 quarts).

Then anesthesia is induced.

Anesthesia.—**PRECAUTIONS.**—If the patient is already in active labor and having pains, chloroform may be used with advantage to begin the anesthesia. As soon as the patient becomes somnolent, it is our habit to change to ether, administered by the drop method. Unless the anesthetist is skillful, it is unwise to entrust chloroform to him, except the few drops necessary to induce the primary stage of anesthesia required for the application of forceps to a head impacted upon the perineum. Chloroform is particularly dangerous for prolonged anesthesia, and this danger is further increased in all conditions of toxemia. The liver of the normal pregnant woman is unduly susceptible to the poisonous action of chloroform; that of the toxemic pregnant patient even more so. Reports of delayed chloroform poisoning, manifesting themselves on the fourth to sixth day, with symptoms resembling those of acute yellow atrophy of the liver, are increasing in number. This unnecessary and fatal complication can be avoided by the use of ether. Severe bronchial or pulmonary affections, however, contra-indicate the employment of ether. Chloroform must then be used if an anesthetic is unavoidable. In choosing the anesthetic it should be borne in mind that chloroform used in an unventilated room, containing a naked flame, generates highly poisonous gases, and that ether fumes (which sink) are inflammable.

DEGREE OF ANESTHESIA REQUIRED.—In primiparous patients, particu-

larly if nervous or exhausted, the introduction of bougies, bags, or gauze into the cervix may require a light, short, primary stage of anesthesia. Ordinarily an anesthetic can be dispensed with.

The low application of forceps for a head on the perineum is facilitated by complete anesthesia during their application. Then the patient may be allowed to regain her consciousness partially (unless she struggles), in order to assist by her own efforts. When the vulva is distending, the anesthetic should again be pushed until the head and shoulders are delivered. Then the anesthesia may be definitely stopped. Neither the delivery of the placenta nor an immediate perineorrhaphy require anesthesia.

When a medium or high application of forceps is attempted, complete surgical anesthesia must be insisted on, in order to permit careful exploration and determination of the fetal position. We maintain complete anesthesia until the head has been drawn down to the pelvic floor, although some operators prefer to have the patient sufficiently awake to assist by her expulsive efforts. The further procedure is as in low forceps manipulation.

Version requires particularly deep anesthesia and complete relaxation. It is especially important when the lower uterine segment has become overdistended, as happens after rupture of the membranes in shoulder presentations. After the version has been performed, the ether is given lightly until the umbilicus is born; then it is again pushed to relax the cervix and perineum during the delivery of the head. In eclamptic patients, however, anesthesia is maintained throughout all manipulations, in order to prevent the occurrence of convulsions.

During *hebesteotomy* complete surgical anesthesia is needed until the pelvic girdle has been severed. Thereafter the anesthetic should be used as in normal delivery, forceps, or version, depending upon the method chosen for terminating the labor.

In *craniotomy*, *embryotomy*, and the various types of *cesarean section*, complete surgical anesthesia is required throughout.

NITROUS OXID.—In the early months of gestation (first to third) nitrous oxid gas, or gas and oxygen may be used while emptying the uterus. Employment of these agents after the third month entails an alarming increase of hemorrhage.

QUALIFICATIONS OF THE ANESTHETIST.—A good obstetrical anesthetist has manifold duties, especially if he is the sole assistant besides the nurse. He must watch the patient's condition, reporting any change to the operator. He will have to give the proper stimulation, should this be needed. He may be called upon to hold or follow the fundus, push from above to assist in the delivery of the aftercoming head, call out the passing minutes during a breech delivery, or help to resuscitate an asphyctic newborn. Whatever calls are made upon his time and attention, he must, however, always bear in mind that his main duty consists in watching the mother.

Disinfection of the Operator and His Assistants.—In no field of surgery are

asepsis and antisepsis more vital than in obstetrics; in no branch is the observance of this necessity more often violated. To-day the wearing of rubber gloves must be insisted upon, and even the general practitioner who does obstetric work should be obliged to use them.

The operator and assistants should scrub their hands and arms well above the elbows with soap and water (green soap or tincture of green soap) for 3 minutes, using a hand brush, then clean the nails and nail beds with a nail file, and again scrub for 5 minutes. After washing off the soap, preferably at the bath tub tap instead of at the small wash basin, at which re-infection is unavoidable, the hands and forearms are rapidly rubbed with a paste made up by mixing a little water in the palm of the hand with equal parts of powdered chlorid of lime and washing soda, for 1 minute. The paste is removed with water, a little 95 per cent. alcohol poured over the hands by the nurse, and the arms and forearms scrubbed thoroughly for 60 seconds in bichlorid solution (1:500).

A sterile long-sleeved gown is donned, the hands dried on a sterile towel (if dry gloves are to be worn), powdered with sterile powder (contained in the sterile glove wrapper) and the glove drawn on *without touching* its outside surface with the bare hand. The cuffs of the gown are covered by the wristlets of the glove. The gloves are washed off with bichlorid at frequent intervals.

This method of disinfection is simple and effective. It is likewise cheap, and the required chemicals occupy little space in the bag. Some operators prefer lysol or alcohol to the above. Lysol has a disagreeable odor, is irritating and poisonous, while alcohol is bulky and expensive. The chemical, so-called disinfecting soaps are an abomination, because their use gives a false sense of security to the ignorant and careless, who frequently employ no other disinfection. Any standard method of hand disinfection, if properly executed, serves the purpose.

Although it is easy to teach almost anyone how to scrub up properly, it is difficult to train practitioners, unused to surgery, to preserve asepsis throughout labor in home surroundings. The temptation and opportunities of touching non-sterile articles are innumerable; the sterile field is often disarranged by the movement of the patient; the emergencies that arise are so trying that faults of asepsis become the rule rather than the exception. It is for this reason that careful preparations are essential and a regular routine necessary.

Throughout all manipulation the vulva and its immediate vicinity—exclusive of the anus—are alone to be considered aseptic. If the operator has touched the leg covers, abdomen, etc., his gloves should be changed, or, at least, thoroughly rinsed in the bichlorid solution.

To recapitulate: The mode of procedure is as follows: The preliminary preparation of the patient is conducted in her own room. The operating room is prepared as described. The patient is now placed upon the table, and an assistant scrubs her up. The anesthesia is started. Meanwhile the operator,

who is ready, makes his final preparations, while his assistant or assistants complete their scrubbing up.

Draping of the Patient.—The anesthetist raises the buttocks by pulling upward on the transverse bar of the Clover crutch, the operator slipping a doubled towel underneath (without infecting himself) in such a manner that it hangs down over the table end. The legs are covered with sterile towels, twisted about them and protecting the feet (wide leggins or sterile pillow cases may be substituted with advantage). A towel is placed upon the abdomen reaching over the pubes, and 2 towels, folded lengthwise, are fastened to this so as to

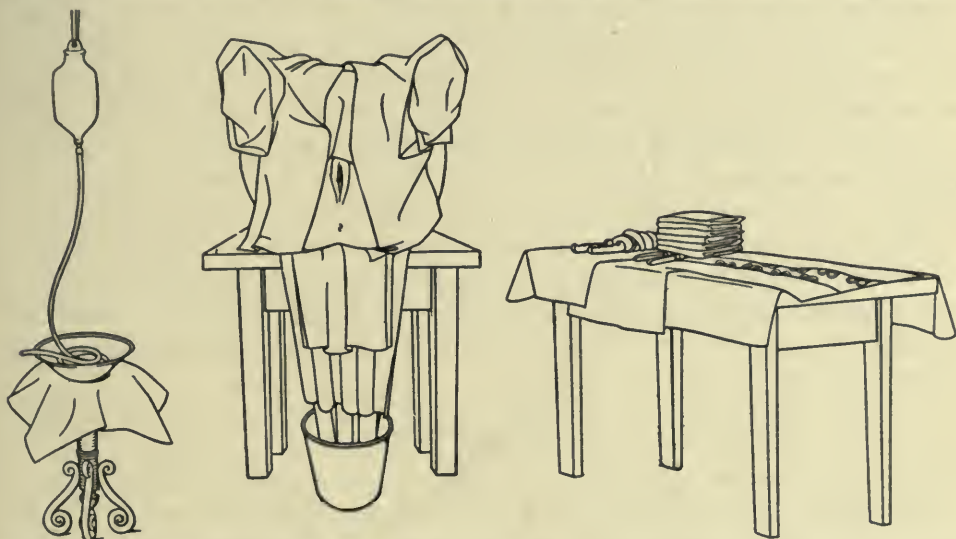


FIG. 3.—HOME OPERATING ROOM. Patient is maintained in the lithotomy position by the Clover crutch (which is concealed by the drapings) and is ready for operation. The instruments are laid out (in their covers) on the table to the right; basin with hand solution and sterile douche, on the left. Instead of a Kelly pad, an oil cloth has been used for drainage into the pail.

frame the vulva. The operative field is thus rigidly limited to the vulvar and perineal region (Fig. 3). During vaginal examinations a gauze sponge is placed over the anus.

Catheterization is then performed with a soft rubber catheter.

Vaginal examination is now repeated because during the time consumed by the preparations conditions frequently change, and because under anesthesia a more complete examination may reveal a previous error in diagnosis. The method of procedure must be based solely upon this final examination, for sometimes it now becomes apparent that no intervention is indicated.

In the succeeding pages such aseptic details as have been described will not again be referred to. Special variations of preparation only will be dealt with.

IMMEDIATE POSTOPERATIVE TREATMENT

It may prove of use, especially for those not well versed in obstetrics, or for the general surgeon who but occasionally performs obstetric operations, to men-

tion at least some of the more essential details to be observed after the completion of obstetric operations.

I have frequently been surprised and chagrined by the casual way with which some obstetricians, who have observed due care in their operative work, leave all after-treatment to the judgment of an inexperienced nurse.

Immediately after the delivery of the placenta, the afterbirth should be minutely inspected, for missing cotyledons or evidence of succenturiata (torn vessels on fetal side of placenta). If any placental tissue has been retained, it may prove necessary, especially in the presence of hemorrhage, to remove such fragments manually, but not until a fresh pair of gloves has been donned. Retained membranes need not be removed. After entering the uterus for placental rests, an intra-uterine douche should be given. Placental retention is favored by too early attempts at Credé's expression, pulling on the cord or attempts to extract the placenta when still in the grasp of the cervix. Only in exceptional instances is haste indicated (placenta prævia hemorrhage).

When the uterus is empty, the patient should be given $1\frac{1}{2}$ drams (6 c. c.) of extract of ergot in 1 oz. (30 c. c.) of water by mouth, if awake, or 1 c. c. (15 minims) aseptic ergot, or 30 m. of ergotin by hypodermic, if under the influence of an anesthetic. Some authors believe that the effect of the injection is hastened if given in the buttock.

At the completion of all operative deliveries (especially forceps, version, vaginal cesarean section or hebstectomy) catheterization should be practiced to make sure that the bladder has remained uninjured. Bloody urine may signify bruising or injury to this viscus and usually demands the employment of a permanent catheter for 1 week.

After version, high forceps, or in the presence of severe hemorrhage, marked collapse, or anemia, the uterus, cervix and vaginal canal must be digitally explored for signs of injury or rupture, in order that appropriate measures may be instituted without delay, if serious damage has occurred.

At the termination of the third stage the fundus should be grasped and controlled. Violent massage is harmful. The organ should be grasped between the thumb and fingers and prevented from overfilling or relaxing to too great a degree by slight anterior, posterior and downward pressure. This control is **gradually** diminished and, if no undue hemorrhage ensues, it is stopped after 1 hour.

As soon as the delivery is completed, the vulva is to be covered by a thick sterile pad, the patient freed from the legholders and drawn back on the table with the knees placed closely together. This posture favors hemostasis. If hemorrhage is at all free, all pads should be kept, in order that the amount of blood lost can be estimated.

For treatment of the various grades of post-partum hemorrhage see page 534.

The anesthetist should watch his patient until she is fully awake. He should control her pulse, see that the room is darkened and ventilated to remove

the anesthetic fumes. He should also supervise and assist in transferring the patient to her bed.

In bed the patient's head should be kept low, hot water bags applied to her feet and warm blankets supplied. If shock has supervened, stimulation, elevation of the foot of the bed, bandaging of the lower extremities (not to be continued longer than 1 hour), and subcutaneous or intravenous infusion of salt solution are indicated, as in purely surgical conditions.

Momburg has devised a method of hemostasis particularly applicable to post-partum hemorrhage, because after the emptying of the uterus the abdominal walls are fully relaxed and flaccid. A thick, elastic rubber tube, 2 yd. long, is wound about the waist immediately above the crests and slowly tightened until the femoral pulse becomes imperceptible. The tube must be applied above (cephalad) the uterus. It is tentatively loosened after 15 minutes. Arteriosclerosis, heart disease, or severe collapse are contra-indications.

Murphy's rectal drip is dangerous unless special precautions are observed. Unconscious or collapsed patients not infrequently expel the fluid, which then collects in the bed and soils the pad and vulva.

If the condition of the patient is alarming, relays of physicians will have to watch her. In such cases, or after tedious or protracted labors, 2 nurses, 1 for the day and 1 for the night, should be on duty.

AFTER-TREATMENT

Care of the Bladder.—If the bladder has been injured, a permanent catheter is retained for from 5 to 10 days. If the perineum was not injured or only a superficial tear sustained, the patient is permitted to void spontaneously. Should retention ensue, the first catheterization is ordered 12 hours post partum. If, however, the lochia are very profuse, the nurse is instructed to catheterize after 6 hours. Even after the repair of deep or complete perineal tears, patients may be allowed to void spontaneously after the first day, without fear of endangering the results of a perineorrhaphy. After each urination the vulva must be irrigated with sterile water and a clean pad applied.

Care of the Bowels.—Unless the perineum has been deeply torn, a thorough evacuation is obtained 36 hours post partum. In private practice castor oil suffices; castor oil need not be insisted on. Thereafter enemata are well borne. After extensive perineorrhaphies, the bowels should remain undisturbed for 3 days; after repair of complete lacerations, for 5 days. Castor oil or a saline purgative is given to produce the first evacuation in such cases (see page 522).

Following laparotomy the bowels are left undisturbed for 36 to 48 hours. Low enemata (soapsuds and peppermint water āā) are then ordered daily. Catharsis is to be avoided.

Diet.—Even after serious vaginal interventions, except in those in which the bowels must be kept at rest, soft diet may be allowed 24 to 36 hours post partum. Where the patient is to be kept constipated, only fluids, and no milk in any form,

are given, until the bowels can be moved, otherwise distention will annoy the patient. After laparotomy the rules and indications of general surgery apply.

Miscellaneous.—Prompt measures to dry up the breasts should be taken if the child has been lost. Mouth temperatures will avoid unnecessary handling and possible contamination of the vulva. Wet dressings to the perineum (aluminum acetate solutions $\frac{1}{4}$ to $\frac{1}{2}$ per cent.) relieve the pain and edema incident to perineorrhaphy. Perineal sutures should be inspected daily and removed any time after the fifth day, if they show signs of cutting through. The descent of the fundus should be controlled from day to day and the amount and character of the lochia noted. It is my practice to allow my patients to sit up in bed on the tenth, and to get out of bed on the fourteenth day, unless some complication develops. Early rising (third day), favored by some, has not proved of advantage in my experience.

The care of the newborn does not fall into the scope of this text book. The routine instillation of 1 per cent. nitrate of silver or 20 per cent. argyrol into the eyes must, however, be mentioned. After operative delivery the obstetrician must assure himself that the child is uninjured. Careful inspection and palpation of the bones of the head, arms, and legs are always indicated. Evidence of paralysis (facial, brachial) must be looked for. Immediate measures to correct or treat injuries, such as depression of the skull, fractures or lacerations of the soft parts, are to be taken. Before leaving the home the cord dressing should be inspected for bleeding.

INDUCTION OF ABORTION (THERAPEUTIC ABORTION)

Induction of abortion implies the termination of pregnancy before the child is viable. Children usually do not survive if delivered before the thirty-second week. The thirty-sixth week or later is the optimum period.

Indications.—It necessarily follows that the operation is performed solely in the interest of the mother. Certain indications are *absolute*, others *relative*. The indications in each individual case must be strictly drawn. For the protection of the operator, a consultation should precede the operation.

ABSOLUTE INDICATIONS.—Absolute indications are acute laryngeal or pulmonary tuberculosis; chronic nephritis, which shows exacerbation with the onset of pregnancy; pelvic contraction, with a true conjugate below 6 to 6.5 cm. ($2\frac{3}{10}$ to $2\frac{1}{2}$ in.) if consent for cesarean section has been refused; and hydatid mole.

RELATIVE INDICATIONS.—Relative indications may be divided into 3 groups, composed of diseases which threaten the life, or seriously endanger the health of the mother, and which are presumably relieved or cured by terminating the pregnancy.

INTERCURRENT DISEASE.—The first group consists of systemic diseases which have existed before or become manifest after the onset of pregnancy. In-

dividualization is here particularly essential, and in most instances a specialist should be called in consultation. A latent tuberculosis, which is not definitely healed, may require abortion. Interruption of pregnancy, to be of benefit in tuberculosis, must be done in the early months. Some authorities prefer non-interference, if the sixth month has been passed. Syphilis rarely warrants this measure; only if severe iritis, cerebral symptoms, and general failure of health appear in the early months, and fail to improve in spite of active treatment—salvarsan, mercury, and iodids (page 555)—need abortion be considered. Severe heart lesions, with marked decompensation, justify termination of pregnancy. In fully compensated valvular lesions, without myocarditis, pregnancy may usually be allowed to go to term. Should disturbances occur, they take place in the later months during labor or the puerperium. Severe arteriosclerosis, especially cerebral, justifies induction of abortion. Diabetes, in which the sugar content of the urine increases under antidiabetic diet, and in which the sugar is accompanied by acidosis (acetone and diacetic acid), warrants abortion. In very rare instances diseases of the special senses, such as rapidly increasing deafness, or alarming loss of sight, become genuine indications. The neuro-retinitis accompanying nephritis, however, regularly warrants induction of abortion. Carcinoma of the breast grows more rapidly during pregnancy; before a radical amputation is attempted the pregnancy should be interrupted. Severe chorea, pernicious anemia, leukemia, and other serious systemic diseases may necessitate abortion. In every such case a consultation should be held.

DISORDERS OF METABOLISM.—The second group of relative indications for the induction of abortion includes anomalies of the metabolism of pregnancy which produce serious symptoms, and are known as the toxemias of pregnancy—hyperemesis, toxemia proper, and eclampsia.

Hyperemesis is typical of the early months. If, in spite of rigid supervision (rest in bed, fluid diet, bromids, and chloral per rectum, rectal feeding, control by a competent nurse), all food is vomited, loss of weight continues and the pulse-rate remains high (100 or more), abortion is indicated. A decision based upon statements of the patient alone is not justifiable.

Toxemia, as a rule, manifests itself after the fourth month. Albuminuria and casts, acidosis (acetone and diacetic acid in the urine), loss of weight, and fever presage a grave condition unless promptly responding to medical measures. If decrease in the size of the liver and the appearance of leucin and tyrosin in the urine are awaited, the condition is, with few exceptions, beyond relief.

Eclampsia at times becomes manifest in the early months, more often in the seventh month or after the child is viable. The indications for interference and the treatment of this disease are dealt with later (page 544). Unless promptly relieved by medical measures, abortion is indicated, especially if the convulsive stage has been reached.

MECHANICAL FACTORS.—The third group of conditions indicating the

termination of pregnancy is composed of disturbances produced by mechanical conditions. In the earlier months (third or fourth) incarceration of a retroflexed gravid uterus, not replaceable even in narcosis, and where laparotomy is refused, justifies abortion. Acute hydramnios, causing pressure symptoms (cardiac, pulmonary), may become an indication. Placenta prævia manifesting itself in the earlier months (fifth and sixth) will usually require interruption of pregnancy. When occurring in the seventh month, and not of severe type, full viability may be awaited if the patient is placed in a hospital. The added risk is, however, rarely justified, as the majority of these children are lost during delivery.

Contra-indications.—In the presence of an acute vulvar or cervical infection, especially if gonorrheal, induction of abortion is attended with grave risk. Almost invariably a severe tubal inflammation, accompanied by attacks of pelvic peritonitis, is set up. In deciding upon the method of procedure, this risk must be considered.

METHODS OF INDUCING ABORTION

First and Second Month.—**CURETTAGE.**—The preparation is that for any perineal operation. Nitrous oxid or ether anesthesia is employed. The cervix is exposed and grasped with a volsellum. The cervix must be well and slowly dilated with a glove stretcher dilator in order to avoid tears. The products of conception are then gently loosened and removed with a sharp curet. The hemorrhage is quite abundant, but ceases as soon as the womb has been emptied. A hot (120° F., 50° C.) intra-uterine irrigation of sterile water is given and the uterus lightly packed with iodoform gauze. A vaginal packing of plain gauze is inserted.

Bimanual examination will show, by the reduced size of the uterus, when this organ is empty. In the first month no fetus will be found. The chorion removed approximates the contents of a walnut in amount. At the end of the second month the fetus is 4 cm. (1½ in.) in size; the chorion will fill 2 table-spoons.

AFTER-TREATMENT.—Rest in bed for 1 week, ergot, 4 c. c. (1 dram), 3 times a day for 2 days; all gauze removed after 24 hours; the bowels moved on the second day.

Patients, after curettage, require morphin, ¼ gr. (0.015), by hypodermic for their pain. After 24 hours codein suppositories 0.03 (gr. ss) suffice. Fever or fever and chills, unless otherwise accounted for, usually indicate an inflammatory process (parametritis or adnexal inflammation). Very rarely a twin pregnancy is overlooked, and the remaining twin and its placenta require removal. Bimanual examination, after completing the curettage, should prevent such retention, as the uterus will be found enlarged. Repetition of curettage for fever is reprehensible. Strictly conservative treatment is indicated—bed, ice-bag, hot sterile douches.

PACKING OF THE CERVIX.—Packing of the cervix may advantageously

precede curettage, particularly after the second month has been reached. No anesthesia is required. Under strict asepsis the cervix is exposed and seized. With a uterine sound a strip of 5 per cent. iodoform gauze $1\frac{1}{2}$ in. (4 cm.) wide is introduced beyond the internal os and the cervical canal firmly packed. The vagina is packed with sterile gauze. The patient stays in bed. After 24 hours the gauze is removed. Not infrequently the entire ovum is expelled with the gauze. Should this not occur, but bleeding prove free and cramps be complained of, it is preferable to wait for 12 hours to see if spontaneous abortion occurs, otherwise curet if necessary. Repetition of the packing is dangerous and favors infection.

OTHER METHODS.—Such methods as the introduction of a sound up to the fundus, or exhibition of oxytoxics are uncertain, and are chiefly used by criminal abortionists to induce bleeding. In Europe, laminaria tents are popular to dilate the cervix, and Hegar's graduated dilators replace the glove stretcher models used in this country.

Third to Fourth Month.—Packing the cervix, as just described, should always be practiced as a preliminary measure. If the indications are very urgent and the cervix rigid, exceptionally vaginal cesarean section may be necessary. The cervix at this stage is softer and more dilatable than in the earlier months. After 24 hours, under anesthesia, the packing is removed and, if the cervix admits the finger, the ovum is first bluntly detached and then removed with the aid of an ovarian clamp. If the cervix is not sufficiently dilated, careful stretching with the dilator will permit the introduction of the finger or clamp and removal, piecemeal, of fetus and chorion. The operation then differs but little from curettage in the earlier months, except that it is more bloody and that greater gentleness must be exercised because the uterine walls are thinner. The uterus does not contract until it is empty. The fetus at the third month is 9 cm. ($3\frac{1}{4}$ in.) in length. The removed chorion corresponds in volume to the size of a lemon.

AFTER-TREATMENT is identical with that of the earlier months, except that an ice-bag is applied to the abdomen if the fundus is above the symphysis.

COMPLICATIONS are rupture of the cervix, which is treated by packing the tear firmly for 48 to 72 hours with gauze, and perforation of the uterus. Uncomplicated perforations are treated by refraining from intra-uterine irrigation and packing with gauze. Such patients must be watched for signs of peritonitis; if this develops, immediate laparotomy with repair of the perforation and vaginal drainage (through the posterior culdesac) must be instituted. Perforation with injury to the intestine demands immediate laparotomy.

Fourth to Seventh Month.—The induction of abortion after the beginning of the fourth month, which coincides with the formation of the placenta, corresponds to induction of premature labor "en miniature." It is inaugurated by methods identical with those for induction of labor. The differences are mainly quantitative, because the smaller size of the fetus makes the observance of a typical mechanism of delivery unnecessary and but rarely requires arti-

ficial dilatation of the vaginal or vulvar canal. The indications have already been described; the methods will be described in conjunction with the induction of premature labor. If indications arise in the sixth to seventh month, conscientious efforts should be made to tide over the pregnancy until the child is viable.

CAUTIONS.—To determine whether the entire placenta has been expelled is usually as easy as at term. If the after-birth has been removed, piecemeal, it may be reconstructed on a towel. Unless the fetus is expelled or extracted entire, the fragments should also be reconstructed. The fetus is always very friable and, during extraction, the head readily tears off. To avoid this accident, cautious traction only should be exerted, the after-coming head may be perforated and seized with placental forceps. If it tears off it should be grasped with a placental forceps; if difficulty arises in its extraction, the cervix and uterus may be firmly packed with gauze for 24 hours. Spontaneous expulsion usually follows. At 4 months the fetus is 16 cm. (6 in.) long; at 5, 25 cm. (10 in.); at 6, 36 cm. (14¼ in.)

INDUCTION OF PREMATURE LABOR

This term implies the artificial initiation of labor after the child becomes viable. Induced labors show greater morbidity, require more frequent operative interference, and exert a greater strain upon the mother than spontaneous ones. This intervention should, therefore, not be practiced without due warrant.

Indications.—Contracted pelvis (requisite is a true conjugate of not less than 7.5 cm. (3 in.)) constitutes an indication for the induction of premature labor. In primiparæ with a pelvis of 8 cm. (3¼ in.) or over, the “test of labor” may be awaited, unless great disproportion develops, as 80 per cent. of such women deliver themselves spontaneously. Diseases threatening the life of the mother also indicate the induction of labor prematurely. These include the diseases mentioned under indications for therapeutic abortion. The larger size of the uterus may, of itself, purely by pressure, produce symptoms as in excessive hydramnios, or a relatively normal uterus may cause serious disturbances in cardiac or pulmonary diseases. Pyelitis of severe type occasionally proves an indication. On the part of the child, overgrowth near term, protracted pregnancy, and habitual death of the child near term are likewise valid indications.

Contra-indications are infection of the vulva and vagina or serious stenosis of the soft parts, not readily overcome by operation.

METHODS OF INDUCING PREMATURE LABOR

The methods to be preferred are those which while inaugurating normal uterine contractions with the least danger of disturbing the presentation or of producing infection, thereupon allow nature to take its course. Special indications demanding immediate delivery may necessitate drastic measures.

Castor Oil.—Near term, especially in multiparæ, the administration of 2 oz. castor oil, followed in 2 hours by 5 or 10 gr. quinin, in 15 per cent. of cases causes the onset of labor within 6 hours. The castor oil should be given between layers of orange juice or sarsaparilla.

Manual Detachment of Membranes.—Near term, under strict aseptic precautions, the gloved finger may be inserted into the patulous cervix and swept around the lower uterine segment to thoroughly detach the membranes. In multiparæ this measure causes the onset of labor in a limited number of cases, but is often followed by premature rupture of the membranes.

Metreuryxis.—After the third month induction of abortion or of premature labor is most safely initiated by the introduction of a bag into the lower uterine segment. From the fourth to the seventh month the cervix may require preliminary dilatation (in primiparæ) by means of gauze for 12 to 24 hours, or by means of a dilator. In more advanced gestation a small bag can at once be inserted (No. 1 or 2). Unless special indications arise (placenta prævia, prolapse of cord, malpresentation, cessation of pains), the labor may be left to nature after the bag is expelled. The technic is described in the succeeding pages (page 453). If, after the expulsion of the bag, the pains subside, a bag of larger dimensions is inserted. In the rare instances of extremely sluggish uterus, where several bags of increasing dimension have failed, the membranes may be ruptured and a considerable portion of the liquor amnii allowed to escape before the introduction of the third bag. The special technic in cases of placenta prævia will be found on page 540.

Packing the Lower Uterine Segment and Cervix.—This method is applicable to all stages of pregnancy. As used in the earlier months, it has already been described. In the later months the same technic is used. The gauze, when introduced in the later months, must be more voluminous. Strips of iodoform gauze, 5 yd. long, 1 to 4 in. (3 to 10 cm.) wide, purchasable in sterile containers, are packed, under guidance of the eye, into the lower uterine segment, care being observed not to rupture the membranes. A blunt curved uterine dressing forceps or an intra-uterine packer is employed. The last 6 in. of the gauze firmly tampon the cervix. A vaginal pack completes the operation. If pains fail to develop within 24 hours, the gauze must be removed and the uterus repacked, unless some other procedure is substituted (metreuryxis). The method is slow and uncertain, and, as in therapeutic abortion, appeals to me chiefly as a preliminary measure to soften a closed and rigid cervix in the fourth to seventh month.

Rupture of the Membranes.—Rupture of the membranes is a slow but certain means of inducing labor. With due asepsis, under guidance of the finger, a uterine sound or closed volsellum forceps is introduced through the cervix and the membranes are punctured or torn. Labor pains set in within hours or days. The main indication is to relieve excessive pressure in hydramnios. It is also of use to afford immediate relief of abdominal pressure in heart or pulmonary conditions. In primiparæ especially, the disadvantages associated with a dry

labor become manifest. To preserve asepsis, the precautions applicable to the treatment of patients after rupture of the membranes (page 438) must be observed.

Introduction of Bougies.—Solid elastic bougies, 35 cm. (13½ in.) long, No. 12 to 16 E, are scrubbed with green soap, and then submerged in bichlorid solution 1:500 for 1 hour. One or more bougies are passed singly through the cervix and pushed upward between membranes and uterine wall, without employment of force. If resistance is encountered, the direction of advancement is changed. The bougies are advanced until all but the ends have passed through the cervix. The vagina is packed with gauze. This method is slow, and not to be recommended. Danger of detaching the placenta or puncturing the membranes exists.

Vaginal Cesarean Section.—Vaginal cesarean section affords a sure means of rapidly emptying the uterus. A description of the technic is given on page 458. This drastic measure is to be employed only in grave emergencies, such as eclampsia and premature detachment of the placenta. It has been recommended in hydatid mole to insure complete emptying of the uterus and satisfactory exploration to determine the presence of chorio-epithelioma.

All of the procedures, with the exception of the last, initiate the onset of labor pains; all can be completed without the use of anesthesia unless the patient proves exceptionally nervous or unruly. Each and every one of them requires due preparation and strict asepsis during and after performance.

PREPARATORY OPERATIONS

The successful delivery of a child through the natural passage, at or near term, requires at least 3 factors: first, a definite degree of dilatation of the soft parts—the lower uterine segment, cervix, vagina, and vulva; second, a certain minimum size of the bony pelvis; and, third, the fetus presenting its longitudinal axis in a deliverable position. The preparatory operations which follow are mainly designed to assist or correct the efforts of nature, where one or more of these primary requisites is lacking, thereby causing dystocia; or where special exigencies arise which threaten the life of the mother or child, necessitating immediate delivery.

PREPARATION OF THE SOFT PARTS

LOWER UTERINE SEGMENT

Anatomy.—Before the onset of labor the lower uterine segment interposes a barrier of variable thickness and rigidity between the fetus and the vagina. This barrier consists of the thick muscular isthmus and the long narrow cervix. In primiparæ quite often during the last weeks of gestation the lower uterine

segment becomes effaced. The remains of the barrier, the effaced cervix, appear as a thick, fleshy septum, stretched over the presenting part or over the bag of waters; with the progress of labor this gradually thins out more and more. Finally the external os dilates until it is sufficiently large to admit the passage of the fetus. In multiparae the process of effacement and dilatation progress simultaneously, so that the cervical canal may persist after 2 to 3 fingers' breadth of dilatation has occurred. The effacement and dilatation of the cervix are accompanied by the loosening and rising up of the bladder above the pelvic brim. The anterior reflection of the peritoneum and the uterine arteries are likewise dislocated upward, the latter also laterally.

From these changes in the anatomy of the parts during labor, it must be apparent that the difficulties and dangers incident to operative dilatation of the cervix decrease in proportion to the degree of effacement and dilatation present. An intact, uneffaced and undilated lower uterine segment is a difficult and dangerous barrier to cross.

Indications for Opening the Lower Uterine Segment.—The indications for opening the lower uterine segment include: (1) all conditions which demand induction of abortion or premature labor; (2) other dangers to mother or child, which can be relieved by emptying the uterus; (3) pathological changes of the cervix, which prevent it from dilating spontaneously and thus cause dystocia; and, lastly (4) those conditions in which the undilated or incompletely dilated cervix interferes with the application of forceps, the performance of embryotomy, version, or other operative intervention.

Indirect Methods of Preparing the Lower Uterine Segment.—Indirect methods act by causing the onset of or stimulating weak pains. Packing the cervix with gauze, rupture of the membranes, the introduction of bougies, etc., have been described in detail (page 451).

METREURYSIS.—**TECHNIC.**—Metreuryisis, which is the most reliable of the indirect methods to be employed at term, is performed as follows: Preparations as for any perineal operation are made. Without the use of an anesthetic the cervix is exposed with specula, and its anterior lip is seized with an ovarian clamp (only in the early months may a volsellum forceps be used). Fifteen per cent. tincture of iodine is then applied to the outside of the cervix and introduced into the cervical canal by means of a sponge on a holder or ovarian clamp. A Voorhees bag, previously rolled longitudinally and grasped with a curved uterine dressing forceps, is carefully inserted through the canal, so as not to produce undue trauma or rupture the membranes (Fig. 4). As soon as the internal os has been passed, the forceps are slightly opened and withdrawn, 1 or 2 fingers of the left hand being used to prevent the bag from slipping out. While the bag is held in place, an assistant slowly fills it with sterile water, injected by means of a piston syringe, until the tubing shows firm tension. The end of the tubing is first clamped with an artery forceps, and later tied firmly with tape. If the introduction has caused bleeding from the cervix, a light pack of iodoform gauze is introduced into the vagina. The tubing, if passed out of

the vulva, is surrounded with sterile gauze, and a split T-binder is applied; or the tubing may be doubled on itself and left in the vagina. As the whole process is conducted under the guidance of the eye, slipping out of the bag, while it is being filled, cannot escape notice.

CAUTIONS.—Bags should be partly distended with fluid before boiling. Before introducing the bag it should be tested for leaks, and the amount of fluid necessary to fill it should be determined. After the bag is snugly rolled, the forceps are applied $\frac{1}{4}$ in. below its upper end in order to avoid rupture of the membranes during introduction. To occlude the tubing, its end should be

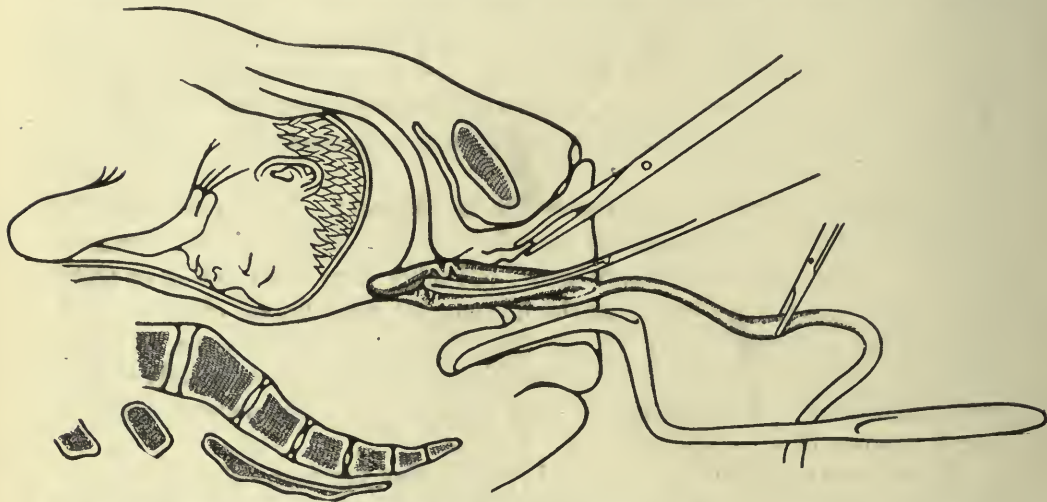


FIG. 4.—INTRODUCTION OF THE METREURYNTER. The perineum is shown retracted by a Brettauer spade. The anterior cervical lip has been seized with an ovarian clamp. The folded bag, grasped near but not at its apex, by a curved blunt intrauterine dressing forceps, is gently pushed through the cervix without rupturing the membranes.

doubled up and tied tightly. To induce abortion at the fourth to sixth month, a No. 1 or 2 bag is best. Larger bags during their expulsion may rupture the cervix and lower uterine segment, causing profound shock and profuse hemorrhage. At term a No. 2 bag can usually be inserted through an apparently non-pastulous cervix, if gentleness and perseverance are employed. Whenever a bag cannot be put in place and haste is indicated, preliminary packing with gauze, or dilatation with a Goodell dilator, paves the way for its introduction. More often a No. 3 bag can be used at once. While the bag is in place, the patient remains in bed. During defecation and urination its tubing is held out of the way by the nurse, and the vulva is then carefully irrigated with sterile water.

FURTHER METHOD OF PROCEDURE.—Pains usually develop within 4 to 8 hours after the application of a metreurynter. Should pains not arise, or should special haste be indicated, contractions may be accelerated by cautious traction exerted by the operator (not by a nurse) for 1 minute, at 5-minute intervals; or a weight of 1 to 2 lb. (0.5 to 1 kg.) may be attached to the tube. After the bag has been expelled through the cervix (this is noted by the advance of the

tubing through the vulva), the bag is emptied and withdrawn. Should the pains then cease for an hour or more, and the cervix prove only partially dilated or again contract, a larger bag is introduced or the membranes are ruptured, depending on indications. It is unwise to leave a bag within the uterus for longer than 24 hours. After this time has elapsed, a freshly boiled bag, usually a larger one, is inserted. After definite pains have set in, the further course of labor is left to nature unless special indications arise. The course may be hastened, the onset of pains may be stimulated, or their strength increased by giving strychnin, 1/30, and quinin, gr. v, alternately every 2 hours, the first by hypodermic injection, the last by mouth.

CONTRA-INDICATIONS TO THE USE OF BAGS.—Vulvar or cervical infections, a firmly engaged head over which the lower uterine segment is tightly drawn, and overdilatation of the lower uterine segment constitute contra-indications to this method.

SPECIAL INDICATIONS.—In addition to the employment of metreuryesis to induce labor, this method is of use to assure more rapid dilatation in dry labor in primiparæ. It is also of value in face and breech presentation when the membranes rupture early. Its use has been advised to hasten dilatation when a prolapsed cord can be replaced, the patient being kept in Trendelenburg's posture. In placenta prævia the hemorrhage may be controlled by intra-ovular metreuryesis (page 540).

DISADVANTAGES.—Sometimes bags fail to produce pains (inertia uteri). Traction or traction exerted after rupture of the membranes, considerable liquor amnii having been allowed to discharge, may remedy this. Occasionally the presenting part may be displaced or the cord may prolapse.

OTHER MODIFICATIONS OF BAGS.—Of the many varieties of bags devised, only the Pomeroy bag needs special consideration. This consists of a bag with 2 compartments, the upper one dilating the lower uterine segment and cervix, the lower one distending the vagina simultaneously. By means of this device, the cervix may be dilated in from 1 to 2 hours, anesthesia being necessary.

Direct Methods of Dilating the Cervix.—Direct methods may be divided into the bloodless and the bloody. Of the former, manual dilatation, dilatation with special instruments, and dilatation by the breech of the fetus must be considered.

BLOODLESS METHODS.—**MANUAL DILATATION.**—Manual dilatation has been employed upon the *uneffaced cervix*. Anesthesia is required. First 1 finger is slowly worked through the cervix, then 2. The 2 fingers are spread apart until a third can be inserted, and the maneuver is continued until the entire hand can enter. Harris exerts dilating force by flexing the fingers after their introduction. A second method is to use first the index fingers of both hands, held back to back, then 2 fingers. Slow and intermittent traction is exerted chiefly in the transverse diameter (Fig. 5). Wedge-shaped pressure upward of the fingers, held in a cone shape, should never be attempted, as it is almost sure to cause serious cervical or even uterine tears. When the cervix is high in the pelvis, bimanual dilatation becomes difficult or impossible. The region of

the anterior lip is always most accessible. The method requires $\frac{3}{4}$ to $1\frac{1}{2}$ hours to accomplish full dilatation, proves exhausting to the operator and is always associated with severe shock to the patient. Deep cervical tears and bruises of the cervical tissues cannot be avoided. The procedure is brutal, and even when it is apparently indicated by urgent complications, vaginal cesarean section is preferable.

If the cervix is effaced and partly dilated, complete dilatation can be effected more readily. The fingers of both hands should be used. The chief indication

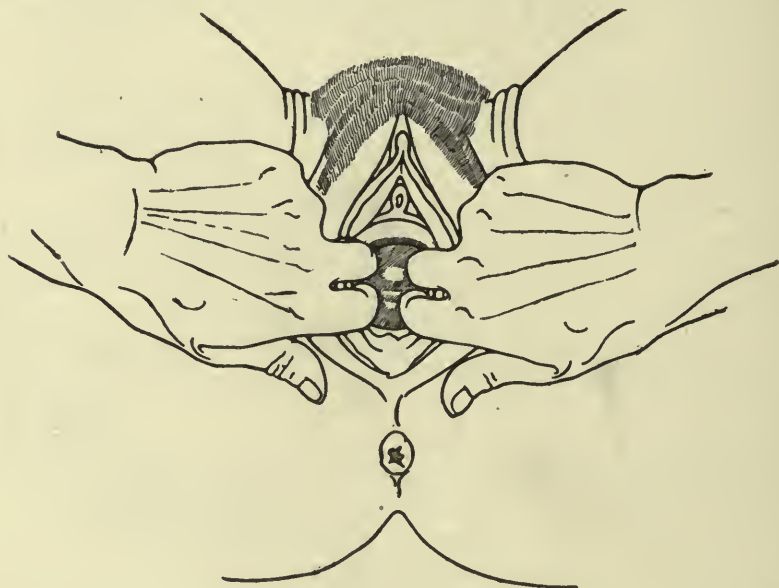


FIG. 5.—BIMANUAL DILATATION OF THE CERVIX. The partly dilated and effaced cervix has been pushed down by the presenting part. The index and middle fingers of both hands are inserted within the cervical rim, exerting traction in a transverse (later in an oblique and anteroposterior) direction.

is prior to performing version and extraction, in order that the cervix should not grasp the neck of the child. Not infrequently the indication also arises when a thin dilatable cervix prevents the application of the forceps.

INSTRUMENTAL DILATATION by the Bossi or 4 or more other branched dilators may occasion severe or fatal tears. Good results have been reported by some. I consider the method dangerous.

DILATATION BY THE FETAL BREECH is described under breech extraction (page 478).

ACCOUCHEMENT FORCÉ.—This term is applied to a combination of cervical dilatation (manual or instrumental), version and rapid breech extraction. It succeeds in combining all the disadvantages of each of these measures. The dilatation causes profound shock and trauma, the rapid extraction enlarges the tears, and the imperfectly dilated cervix frequently arrests the after-coming head, causing death of the child. This procedure is particularly fatal in

placenta prævia and is not warranted in eclamptics, who are notoriously sensitive to shock. Rupture of the uterus is a common sequel.

BLOODY METHODS include Dührssen's radial incisions and vaginal cesarean section.

RADIAL INCISIONS.—Radial incisions should be practiced only if the cervix

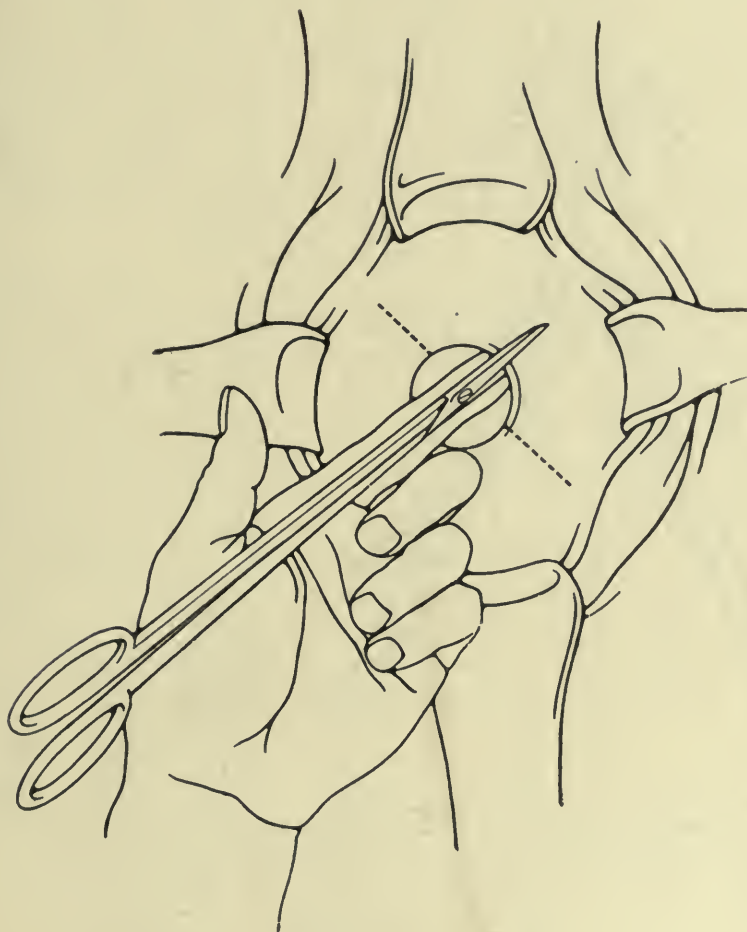


FIG. 6.—RADIAL INCISIONS INTO CERVIX. For the sake of clearness the fully effaced, but only partly dilated cervix has been exposed with retractors. A finger is seen inserted between the cervix and the presenting part. Upon this, as a guide, one blade of the scissors is introduced. The dotted lines show the direction and extent of the incisions.

is effaced and partly dilated and the head low and well engaged. Indications are a thin cervical ring, which prevents the application of forceps, or a similar rim constricting the neck below an after-coming head.

In the first instance, the cervix may be exposed with specula, and radial incisions, 2 or 4 in number (2 cm. or 1 in. long), may be made in the direction shown in Figure 6, with blunt-pointed scissors. Transverse incisions, if they

extend during further manipulations, may tear the uterine artery or its larger branches; anterior incision may extend into the bladder.

When the constricting ring prevents the extraction of the after-coming head, incisions must be rapidly made, under guidance of the finger, while an assistant

raises or lowers the body of the child. For both these indications I prefer manual dilatation (effaced cervix) practiced before attempting version or application of forceps. The incisions may extend during extraction, producing serious lacerations and grave hemorrhage.

VAGINAL CESAREAN SECTION (HYSTEROTOMY).—Vaginal cesarean section is a truly surgical method which enables the operator to empty the uterus within 5 to 30 minutes at any period of gestation. It requires a considerable experience in vaginal and obstetric technic, proper surroundings, and sufficient assistance (anesthetist and 2 assistants). Wherever these requisites are procurable, this method should supersede manual or Bossi's dilatation, and its development has completely robbed *accouchement forcé* of any *raison d'être*.

Indications are conditions requiring immediate rapid emptying of the uterus, such

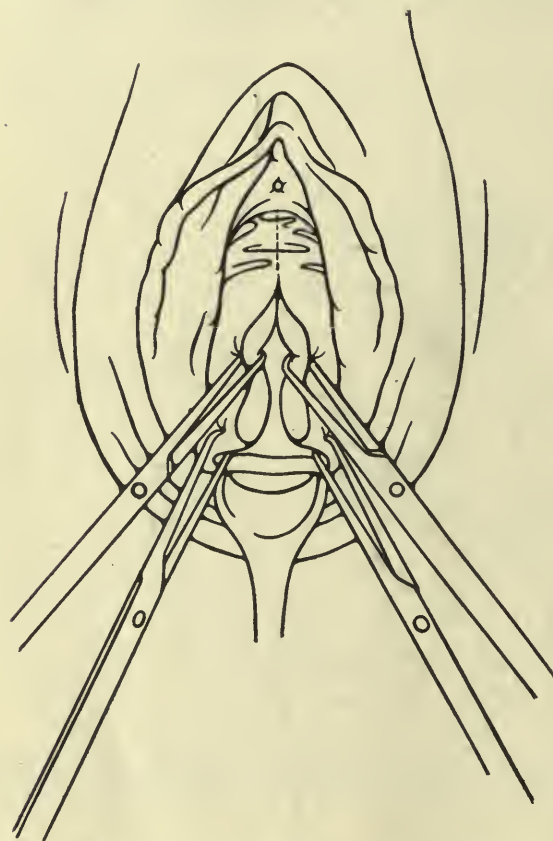


FIG. 7.—VAGINAL CESAREAN SECTION; SPLITTING THE CERVIX AND LOWER UTERINE SEGMENT. The cervix is partly split; the dotted line showing full extent of the incision through the vaginal mucous membrane. Unless the patient has been in labor for some time the lower border of the bladder will be encountered at the upper margin of the cut already made. The method of grasping higher segments with bullet forceps is shown.

as severe eclampsia and premature detachment of the placenta. It is dangerous in placenta prævia, where the highly vascularized cervix bleeds alarmingly and may tear extensively during extraction. The operation is more readily performed on multiparae. In a primiparous patient it may prove necessary to combine Dührssen's vaginal incision and vaginal cesarean section, which adds considerably to the gravity of the intervention. Difficulty in exposing the higher regions of the cervix (anteriorly) is, even then, of frequent occurrence.

Contra-indications are immobility of the cervix, infected cases, contracted pelvis.

Technic.—Under anesthesia, in the lithotomy position, and after all due preliminary preparations (catheterization) have been completed, the anterior lip of the cervix is seized and drawn down with 2 volsellum forceps. With a straight scissors, the anterior lip of the cervix is split through its entire thickness for 2 cm. (Fig. 7). If labor has not yet set in, the lower border of the bladder becomes visible; if labor is in progress, the bladder has retracted upward to a variable degree. The one blade of the scissors is now carefully inserted between the bladder wall and the anterior vaginal wall and burrowed upward to within a short distance of the urethra, and the mucosa is cut through. By means of the finger or gauze sponge, the bladder is stripped from the cervix as high up as possible, both mesially and for a distance of 2 cm. to either side, and held out of the field by the anterior spade. The cervical incision is extended upward, additional volsellum forceps being applied every inch to grasp the cervical wound edges higher up and drag the higher segment into view.

By thus grasping segment after segment, removing the lower volsella after the higher ones have been placed, the volsella do not tear out, and better exposure is obtained. If the peritoneal reflection becomes visible and hampers extension of the cut, it is pushed up by means of a gauze sponge. The lower uterine segment is grasped in turn and incised. By keeping strictly in the median line and by constant downward traction, hemorrhage is well controlled. The bulging membranes, if still intact, will protrude in the vertical gap. Should an incision of 10 to 12 cm. ($3\frac{3}{4}$ - $4\frac{1}{2}$ in.) not give sufficient space for delivery, the posterior cervical lip is grasped, pulled forward, and split in the median line. Just above the fornix the peritoneum of Douglas' culdesac appears in the incision and is stripped upward to permit of further extension of the cut. The membranes are now ruptured, all instruments removed, and delivery effected by forceps or by version and extraction, according to indications. The placenta may either at once be expressed or manually extracted. Or, if hemorrhage is not too profuse and a certain amount of loss of blood is desirable (as in eclampsia), its spontaneous expulsion may be awaited. A hypodermatic injection of ergot is given. The spades are re-inserted, the anterior lip of the cervix grasped as before, and the uterus tightly packed with gauze if hemostasis is necessary.

Repair of the incision or incisions completes the operation. To accomplish this successfully, good exposure is essential. The anterior spade retracts the bladder; the uterus is pushed down by external pressure, and the cervical edges are grasped by means of volsellum forceps placed one above the other, at intervals of 1 in., as the higher segments are drawn down into view. This step by step exposure minimizes the danger of extending the cervical incision by tearing. Tears of the peritoneum roofing the anterior culdesac are looked for, and, if present, are at once repaired with a continuous suture of plain catgut. The upper angle of the uterine wound, thus brought into view with volsellum forceps, is closed with interrupted sutures of No. 2 chromic catgut, not including the

uterine mucosa (Fig. 8). The remainder of the cervical wound, down to its junction with the vaginal mucosa, is closed with running chromic gut stitches similarly placed. It is well to tie at every fourth stitch. The cervix is now drawn strongly forward, and the posterior incision closed in a similar manner, equal care being exercised to approximate the upper angle of the incision. A few sutures close the wound in the posterior fornix. Again drawing the cervix

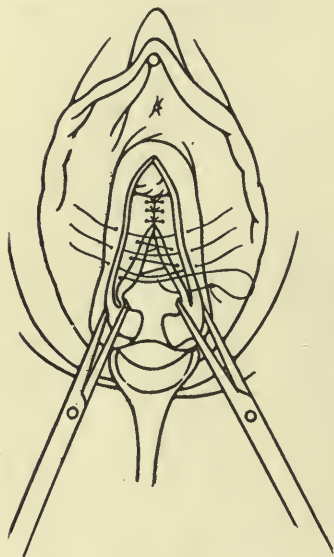


FIG. 8.—SUTURE OF INCISION AFTER DELIVERY BY VAGINAL CESA-REAN SECTION. At the upper angle of the wound the bladder has been allowed to prolapse, covering the highest of the interrupted sutures already placed in the lower uterine segment. Three interrupted sutures are shown. Below this a continuous suture has been passed but not approximated. Three superficial (vaginal) sutures have been inserted.

downward and backward, the uterine gauze is adjusted so as to be readily removable. It should project at least 8 to 12 cm. from the external os. If haste is not essential, and the bladder shows marked tendency to prolapse, a few chromic gut sutures uniting the lateral fascial planes in front of the cervix will serve to prevent cystocele formation (Vol. V, p. 253-254). A narrow strip of iodoform gauze is inserted nearly up to the bladder and allowed to project between the just completed suture and the few separate through-and-through sutures which close the lowest portion of the cervix including the vaginal mucosa. The narrow drainage gauze is marked with a piece of catgut tied to it, and left projecting from the vulva, and the vagina is packed with gauze.

Modification.—Dührssen (5) has suggested a further simplification. Instead of volsellum forceps a large metreurynter (holding at least 500 c. c., if applied at term) is inserted into the uterus, dilated with fluid, and used as a tractor. This has a two-fold advantage—volsella are dispensed with and, when the bag is born through the incision or incisions, the operator is assured that a full-sized head can be delivered through the opening. Inexperienced operators frequently make the mistake of not incising sufficiently.

This modification prevents this error and the consequent tears resulting during extraction. (Fig. 9.)

After-treatment.—The vaginal and uterine gauze is removed after 24 hours. Except that morphin may be required after operation, the patient is treated exactly like a case of normal delivery. If the bladder has been injured and sutured, a permanent rubber catheter is retained for a week.

VAGINA AND VULVA

The soft parts of the lower genital tract more rarely interpose serious obstacles to delivery.

Vagina.—Rarely, solid or cystic tumors of the vagina, stenoses—congenital or acquired—longitudinal septa, etc., produce dystocia. Cystic tumors may have to be emptied by aspiration late in labor. Stenoses, if neither too rigid nor narrow, may be dilated and softened with a colpeurynter inserted at the beginning of the first stage. Solid tumors, rigid and narrow stenoses, and scars from vesicovaginal fistulæ may indicate abdominal cesarean section in clean cases, or craniotomy or embryotomy in suspected cases. Septa, both longitudinal or transverse, if not too rigid, are permitted to be stretched and softened by the advancing part, and then cut with scissors under guidance of the eye. Immediately post partum, if bleeding persists, the bleeding points in the vagina must be caught and ligated.

Vulva.—At the end of the second stage a rigid vulvar ring may impede spontaneous delivery of the head. More often the dystocia is due to the bony outlet (acute subpubic angle and closer approximation of the tuber ischii than normal). Indication for enlarging the vulvar orifice is given most commonly by friability of the soft parts, which threaten (blanching,

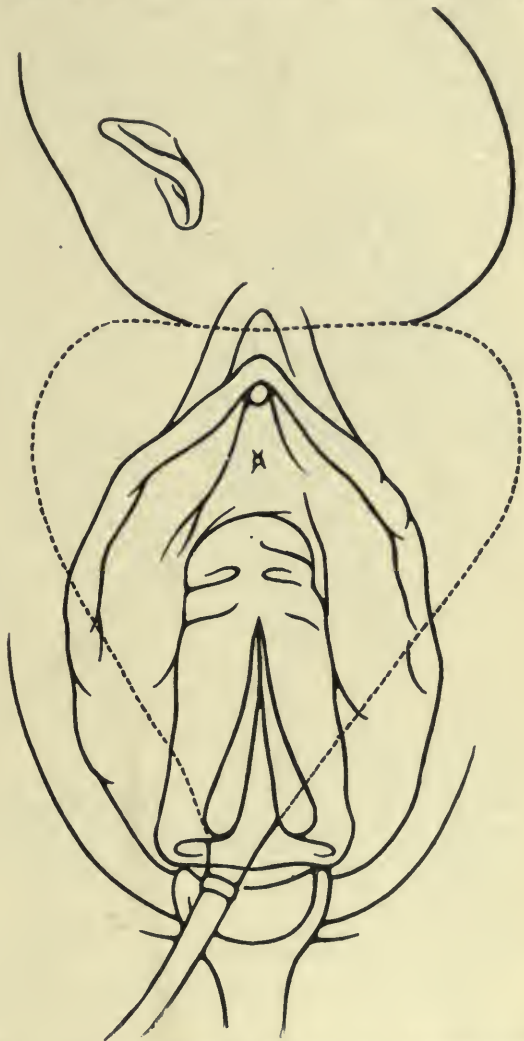


FIG. 9.—VAGINAL CESAREAN SECTION; THE METREURYNTER USED AS A TRACTOR. A metreynter has been inserted into the uterus and filled. By means of strong traction exerted on the tubing the cervix is pulled into sight, and split. No volsella are required. When by means of an anterior, and, if necessary, posterior incision, a bag containing 500 c. c. (16 oz.) can be pulled through, a full term head can be delivered through the incision.

edema) to tear in an unfavorable direction, i. e., into the rectum. Infantile vulva, hematoma, and operative scars tend to increase the resistance offered and the damage to be sustained. Unfavorable positions, as occipitoposterior, a large fetal head, or obstruction to the after-coming head in breech extraction,

favor dystocia and injury. Under these and similar conditions, the vulva is not incised until overdistention becomes apparent. When the vulva hampers operative delivery—as in vaginal cesarean section, craniotomy, etc.—the incision is made earlier in the delivery.

EPISIOTOMY.—Episiotomy, either unilateral or bilateral, requires anesthesia. When the perineum is distended by the presenting part, one blade of a heavy, blunt-pointed scissors is inserted within the vulva, and is directed down-

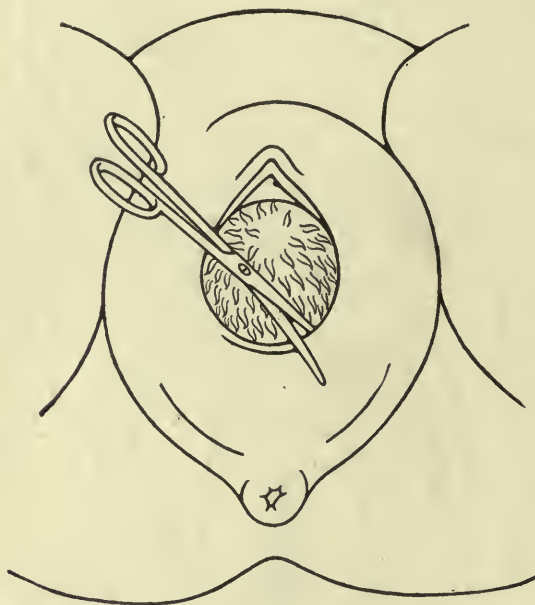


FIG. 10.—EPISIOTOMY. The head has dilated the vulva and threatens to rupture the greatly overdistended perineum. The inner blade of the scissors has been slipped between the head and perineum. The extent and oblique direction of the proposed incision are indicated.

ward and outward toward the tuber ischii. With 1 cut the skin, fascia, constrictor cunni, and vaginal mucosa are severed for 2 to 3 cm. ($\frac{7}{8}$ to 1 in.), starting at the junction of the upper $\frac{2}{3}$ and lower $\frac{1}{3}$ of the labium, below the Bartholinian opening (Fig. 10). After delivery the wound will gap in an elongated diamond form. By approximating the mucocutaneous junctions at A and B, normal relations at once become apparent. Unless care is taken first to reestablish normal relations, the beginner will unite skin to mucosa. The intravaginal wound is sutured with a running or interrupted chromic catgut suture (No. 2) including the muscle, fascia, and mucosa. The perineal wound is then closed with 2 or 3 deep inter-

rupted sutures of silk or silkworm-gut (Fig. 11).

If episiotomy is performed bilaterally, the incisions must not approach each other too closely in the median line, otherwise the resulting central triangle, situated above the anus, is narrow, poorly nourished, and may slough off.

DÜHRSSSEN'S INCISIONS.—Dührssen's incisions are episiotomy wounds carried further upward and downward in order to incise the levator ani as well as the constrictor cunni. They are indicated to open up the vagina and vulva for vaginal cesarean section, high forceps, etc., in primiparæ. The cut extends midway between the anus and tuber ischii, reaching upward 4 or 5 cm. ($1\frac{1}{2}$ or 2 in.) into the vagina. Approximation is obtained as in the previous operation.

ENLARGEMENT OF THE PELVIC CAVITY

POSTURAL ENLARGEMENT

Both the pelve inlet and outlet can be appreciably increased by posture.

Walcher's Position.—Walcher's position, which enlarges the true conjugate from 0.5 to 1.0 cm. ($\frac{1}{5}$ to $\frac{2}{5}$ in.), favors engagement in slight degrees of disproportion. It also proves of service during high forceps delivery until the head has entered the pelvis. (Instead of this, the lithotomy position is commonly used, which actually decreases the diameters of the inlet.) No patient can tolerate this uncomfortable and strained position for more than half an hour without anesthesia (Fig. 31).

The parturient is drawn down to the edge of the table until the lower end of the sacrum and edge correspond (small hard pillow under sacrum); the spread legs are lowered and permitted to hang down. The entire sacrum must be fixed, by being on the table; otherwise, the overextension which is desired does not result. The haphazard drawing of the patient down to or over the edge of the table is of no value. Labor is allowed to progress or forceps traction instituted, as the case may be. When the head is in the pelvis, the lithotomy position is then to be assumed.

Exaggerated Lithotomy Position.—This position slightly increases the diameters at the outlet. It is, therefore, of use in slight degrees of disproportion after the largest circumference reaches the bony outlet. This is frequently illustrated when patients are placed upon the table in this posture to be delivered by a forceps operation; in many instances spontaneous expulsion occurs as soon as the legs are flexed, abducted, and the thighs forcibly flexed upon the abdomen.

OPERATIVE ENLARGEMENT

Considerable temporary enlargement, and not infrequently a permanent increase of lesser degree, may be obtained by severing the pelvic girdle at or near the symphysis pubis. In symphysiotomy the joint surfaces and in pubiotomy the severed ends of the ramus may be separated for a distance of from 2 to 5 cm. ($\frac{4}{5}$ to 2 in.). This separation is favored by the increased mobility of the pelvic joints, especially of the sacro-iliac articulations, physiological in pregnancy.

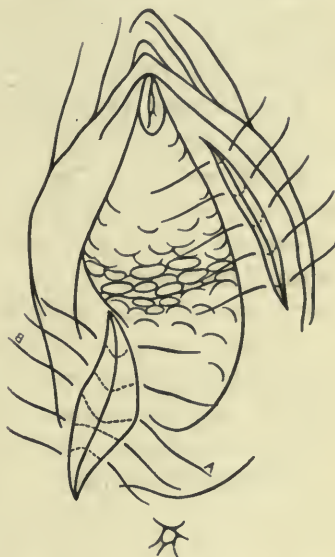


FIG. 11.—SUTURE OF EPISIOTOMY INCISION—SUTURE OF LABIAL TEAR. Suture A B is passed at the mucocutaneous junction. With it as a tractor and guide interrupted or continuous vaginal and perineal sutures, including the lateral tissues widely, are readily passed. Above, a tear of the right labium and the method of repair is shown.

Theoretically the operations are ideal, because they increase all of the pelvic diameters and enlarge the capacity of the pelvis. Studies on the cadaver have shown that a separation of 3 cm. (1 1/10 in.) enlarges the conjugata vera 1 cm. (3/10 in.), the transverse 1.5 cm. (1 1/2 in.); a separation of 5 cm. (2 in.) is the utmost limit permissible because of overstretching of the sacro-iliac joints. The diameters of the outlet are, likewise, increased slightly. In practice hebosteotomy has proved disappointing, except when rigidly limited to definite indications. A great advance over the early open symphysiotomy was made with the introduction of subcutaneous hebosteotomy, but even in its improved form the operation does not have a broad field.

Hebosteotomy (Pubiotomy).—DISADVANTAGES.—The disadvantages and dangers of hebosteotomy—for at the present day symphysiotomy is practically discarded—are as follows: A communicating tear from the vagina converts the wound into a compound fracture bathed with infected secretion (the lochia) and exposes the patient to the dangers of sepsis. In every case the corpus cavernosum of the clitoris with its enlarged veins is torn across as the bones separate, several cases of uncontrollable and fatal hemorrhages therefrom being on record. Severe injuries to the urethra and bladder, though occurring less often than after symphysiotomy, may result. The main disadvantage of the operation is that, after separating the pelvic girdle, it is impossible to foresee or foretell the complications that may arise from these causes during delivery.

CONTRA-INDICATIONS.—The disproportion between head and pelvis must not be excessive, otherwise hebosteotomy fails to afford sufficient additional space. Large vulvar varicosities contra-indicate the operation. Primiparity, in the great majority of cases, likewise contra-indicates, because the rigid soft parts favor the formation of communicating tears. Definitely infected cases should also be excluded, as the danger of sepsis is too great. The operation should not be performed if the child is in poor condition. If anterior vaginal tears have already occurred earlier, during attempts at delivery, the operation is not to be considered. Deformed pelves, particularly those with ankylosis of the sacro-iliac joints, are also to be excluded.

INDICATIONS.—Hebosteotomy should only be undertaken if the degree of disproportion is slight—in other words, the main circumference of the head must be nearly able to enter the inlet before the bone section has been done. In breech presentation, therefore, it is impossible to gauge the disproportion until the head reaches the brim. The main indication is the dystocia arising from contracted pelvis. A true conjugate below 7 cm. (2 4/5 in.) in a simple flat pelvis, or 7.5 cm. (3 in.) in a justo minor one, per se, bars hebosteotomy. Occasionally the operation has been performed for undeliverable face or persistent occipitoposterior positions, or for delivery of the after-coming head. In the last instance the bone section must be made before the umbilicus is born, or, as some authors prefer, the saw can be inserted prophylactically, and if the head then meets with obstruction during delivery, the bones are rapidly severed (Roemer, 17).

TECHNIC.—The pubic region, lower abdomen, and vulva are shaved, the bladder catheterized, the entire region disinfected, the buttocks drawn to the edge of the table, and the thighs held horizontally separated by 2 assistants. Usually the left side is selected. By the subcutaneous method of Doederlein, a small transverse incision (2 to 3 cm.— $\frac{2}{3}$ to 1 in.) is made, cutting boldly down to the upper edge of the pubic bone at a distance of 2 cm. ($\frac{2}{3}$ in.) from the median line, corresponding to the spine of the pubis. Only the skin, subcutaneous fat, and insertion of the rectus are severed. Spurting vessels are caught and ligated. The index finger of the left hand burrows downward (keeping close to the posterior surface of the pubic bone), pushing away the bladder. With the finger in the incision, the Doederlein carrier is carefully inserted between the palmar surface of the index finger and bone, until it reaches the lower border of the symphysis. The carrier is now rotated on its long axis, which causes the blunt point to protrude against the skin of the labium majus. The labium

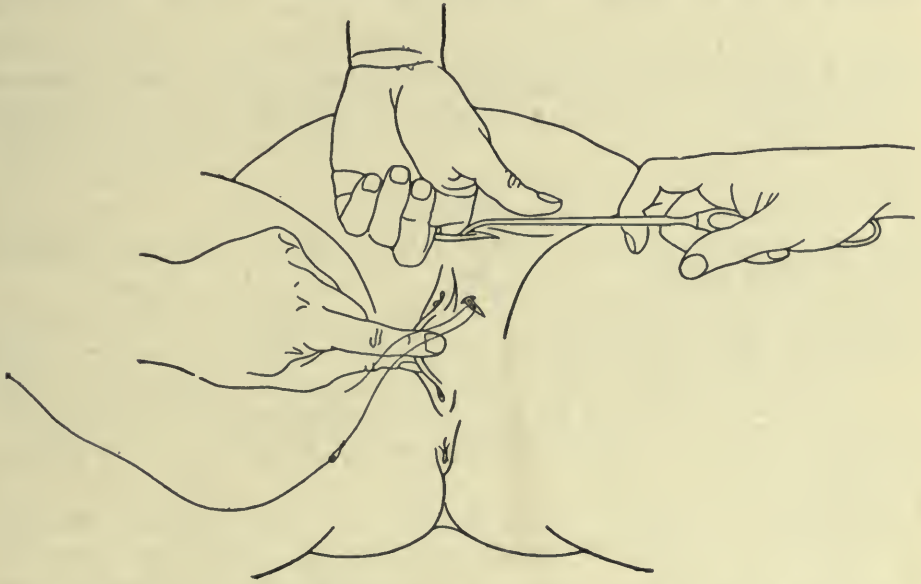


FIG. 12.—HEBOSTEOTOMY. The patient's legs are held abducted. The suprapubic incision, to the left of the median line, has been completed and the operator has inserted the index finger of his left hand behind the ramus of the pubic bone. With his right hand he has guided the needle between finger and bone until it reached the lower margin of the os pubis. The assistant is seen pulling the labium to the right. By slightly rotating the needle, its end has been forced under the skin, and pushed through a minute counterincision. The needle is shown threaded with a silk carrier to which a Gigli saw has been attached. The operator now withdraws the needle along the course it was introduced, thus pulling the saw into position. (Modified from De Lee.)

is pulled toward the median line (to favor a trap-door closure and a wound removed from the vulva), and a minute counterincision made upon the blunt point of the instrument. One end of a Gigli saw is engaged in the hook of the carrier, which is then withdrawn by the same route, carrying the saw with it (Fig. 12). With the saw in place, its handles are attached and the bone is severed from before backward. The saw wire should be kept as nearly straight

as possible during this process, by moving the handles up and down, in order to avoid breaking the wire. It is well to have at least 3 saws on hand, in case 1 or more break. When the bone is severed, the characteristic bone resistance ceases, and not infrequently a distinct cracking sound may be heard. The assistants steady the pelvis and counteract any tendency to excessive separation. The saw is now withdrawn, and counterpressure exerted from above, against the upper wound, and below, from within the vagina, by means of gauze pads, to control the free oozing. Usually within a few minutes bleeding ceases. The suprapubic wound is then closed by 2 or 3 silk skin sutures, the labial cut by a single stitch.

The amount of diastasis of the bone ends can be controlled by means of the palpating finger in the vagina. A separation up to 5 cm. (2 in.) is permissible, though usually not practiced. Delivery is then left to nature, whenever possible, or terminated by forceps or version, as indicated. The assistants support the thighs throughout.

After delivery a catheter is introduced. Should the urine prove bloody (bruise or tearing injury), a permanent catheter is retained. The vagina, especially the anterior vaginal wall, is palpated and inspected for tears communicating with the bone. If such are present, they are sutured as well as possible, but also drained into the vagina with gauze. In every case the vagina should be firmly tamponed with iodoform gauze for 12 to 24 hours to exert counterpressure and prevent the formation of a hematoma. Finally the pelvis is immobilized by 1 or more broad circular turns of adhesive straps placed at the level of the trochanters.

The patient must be kept in a dorsal posture, with thighs and pelvis supported by sand-bags, for 1 week. A sharp lookout for hematomata must be kept up. If such accumulation occurs, it must be emptied and drained through the wound. Thrombophlebitis is treated by rest and ice-bags. The patients, even in uncomplicated cases of hebosteotomy, are not permitted to walk before 3 weeks have elapsed.

OPERATIVE ACCIDENTS.—Excessive bleeding occurring immediately after the bone section is controlled by packing inserted from above and counterpressure in the vagina (gauze). In some cases it has been found necessary to expose the bone ends, making an open wound, carrying the incision from the labium to the suprapubic wound. Three deaths from uncontrollable hemorrhage are recorded.

VARIATIONS IN TECHNIC.—Bumm uses a sharp-pointed carrier which he introduces into the labium, controlling its course by means of a finger placed in the vagina, pushes it upward along the posterior surface of the pubis, and forces it out through the skin of the pubic region. More bladder injuries are recorded from this method. Other variations, such as subperiosteal introduction, etc., offer no special advantages.

EFFECT ON SUBSEQUENT LABORS.—No permanent enlargement of the pelvis results in most cases. The course of subsequent labors depends upon the size of the child. Repeated hebosteotomies have been performed on a few

patients. (For the literature, see van de Velde, M. H., 26, and Jellinghaus, 11.)

Symphysiotomy.—Symphysiotomy can be performed by the open or the subcutaneous method. The pelvic enlargement is similar to that obtained by pubiotomy. Bladder and urethral injuries are common. Hebosteotomy has superseded the operation almost completely. Hartmann (7) reports 131 cases with 2 deaths, using the subcutaneous method.

Resection of the Promontory.—Resection of the promontory, an operation devised independently by both Rotter (18) and by H. H. Schmid (19), consists of the transperitoneal removal of the greater part of the bodies of the fifth lumbar and first and second sacral vertebrae. The true conjugate diameter is increased by $1\frac{1}{2}$ to 2 cm. ($\frac{1}{2}$ to $\frac{4}{5}$ in.). The operation has been practiced only once during pregnancy and 7 times after completing cesarean section. It is still too untried to deserve more than passing mention.

The preparatory operations now to be described change the fetal presentation, serving to make the long axis of the fetus correspond to the axis of the parturient canal, or substituting a more favorable for an unfavorable or undeliverable presentation.

VERSION

Version, unless at once followed by extraction, is a purely preparatory operation. It changes the longitudinal axis of the fetus with reference to its relation to the axis of the maternal birth passages, either converting a transverse presentation into cephalic or breech presentation, or substituting one fetal pole for the other (as conversion of a cephalic into a breech presentation, or vice versa).

Indications.—The indications for version are maternal and fetal, usually a combination of both. When version is performed in placenta prævia, it is done solely in the interest of the mother, because tamponade by the breech usually entails the death of the fetus. On the other hand, version for prolapse of the cord is performed solely in the interest of the child. The usual indications are: (1) shoulder or transverse presentation; (2) unfavorable cephalic presentations (face with chin posterior, brow, or posterior parietal bone) in which application of forceps is contra-indicated; (3) prolapse of the cord or extremities; (4) placenta prævia; (5) necessity for immediate delivery, when forceps are contra-indicated (eclampsia, premature detachment of placenta). Some authors perform version "prophylactically" in simple flat pelves with true conjugate of 8.5 cm. ($3\frac{3}{10}$ in.) or more, because the after-coming head presents smaller diameters and enters in the favorable, transverse, diameter of the inlet. The disadvantages accruing from the necessity for rapid delivery of the unmoulded head often outweigh the advantages; the method is less popular than formerly, since spontaneous delivery has been found to occur in 80 per cent. of these cases, and hebosteotomy or cesarean section also offers a method of delivery safer to the fetus.

The special advantages and indications of each method will be detailed in connection with the technic.

Varieties.—If the head is converted into the presenting part, the version is termed *cephalic*; if one or both legs are pulled down, *podalic*. If the turning is performed by external maneuvers alone, the method is termed *external version*; when one hand is used externally and 2 or 3 fingers of the other hand assist through the partly dilated cervix, it is termed *bipolar*, *combined*, or *Braxton-Hicks* version; and when the entire hand is introduced into the uterus, to



FIG. 13.—EXTERNAL CEPHALIC VERSION. The fetus lies transversely (left scapula anterior). By stroking motions, executed between pains, the operator's right hand pushes the head downward and to the left, his left hand simultaneously moving the breech upward and to the right. When the head is over the inlet the version has been completed.

change the posture, the term *internal version* is employed (although, as in the combined variety, the external hand gives material aid).

External Version.—External version is a safe and harmless procedure; it is, however, applicable in only few instances. It may be tried at the beginning of labor, if the pains are good, the cervix partly dilated, the membranes intact, and the fetus freely movable. No anesthesia is required. The patient is placed in dorsal posture with the thighs well flexed and head slightly elevated. The vulva should be rendered aseptic. The obstetrician then places his flat hands on the patient's abdomen and endeavors with stroking movements to rotate the fetal poles during pauses between the pains.

Taking a transverse presentation for example—let us say, scapula left anterior—to be converted into a cephalic presentation, the operator, standing on the patient's right side, strokes and pushes the head downward and to the right with his right hand, and simultaneously pushes the breech upward and to the left with his other hand (Fig. 13). As soon as the head is above the inlet, it is steadied and pushed downward, by an assistant, until the operator can disinfect himself and rupture the membranes. The head is held in place from above until it is engaged.

Attempts to change the position, before labor has set in, are usually only temporarily successful, as all bandages, pads, etc., fail to maintain the corrected posture. If the malposition is due to contracted pelvis, external version will rarely prove successful; if the indication for version demands immediate delivery, this method is not to be employed. It is most often successful in lateral deviations of the fetus due to the lax abdominal walls of multiparæ.

A modification of external version is the *squatting posture*, recommended by King, in which the turning (for correction of transverse presentation) is effected by the patient's knee pressing against her abdomen, in the region of the breech (King, 13).

Bipolar, Combined, or Braxton-Hicks Version.—This is a method intermediate between purely external and internal version. Its chief advantage lies in the fact that it can be practiced after only slight dilatation of the cervix has been attained, enabling the operator to gain control of the fetus early in labor.

INDICATIONS.—Its chief uses are: (1) in drawing down 1 leg for tamponade and control of hemorrhage in placenta prævia (page 540); (2) in hastening delivery in eclampsia (page 545); (3) in converting a transverse into a breech presentation, if the shoulder has not become firmly engaged.

To perform bipolar version successfully, the cervix must admit 2 fingers, the uterus must be relaxed, the fetus fairly movable. Consequently it is not applicable if tonic contractions persist and the waters have drained off.

TECHNIC.—The patient is placed in the lithotomy position, the vulva disinfected, anesthesia induced (not absolutely essential in emergencies), and the bladder catheterized. The presentation is determined accurately. The labia are separated with the left hand, and the right hand is slowly inserted through the vulva (fingers held cone-shaped). The index and middle fingers are then introduced into the cervix.

Let us take, for example, a cephalic left dorsal position, which we desire to convert into a breech presentation. The fingers of the internal hand gently push the head upward and along the left wall of the uterus, while the external hand pushes the breech downward and to the right. As the head recedes, the breech is forced downward; possibly the chest of the fetus (especially in face presentation) may come within reach of the internal fingers. If so, it also is pushed upward and to the left. Finally the small parts, either knee or foot, are felt descending along the right wall of the uterus (Fig. 14). If the membranes are intact, they are now ruptured, and a foot (recognized by the heel) is seized by

the ankle between the 2 fingers and slowly drawn downward, while the external hand, now working along the mother's left side, aids by elevating the head. When the foot appears at the vulva, the version is completed. During uterine contractions all external and internal manipulations must cease.

Early in labor, a transverse or shoulder presentation may often be successfully changed in a similar way, by either converting it into a cephalic or breech presentation. To convert a shoulder into a head presentation, the internal

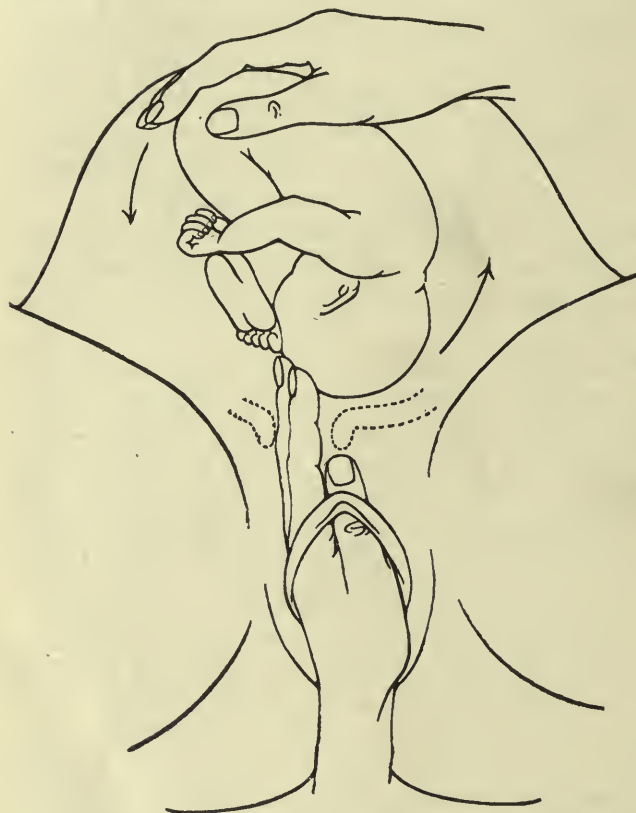


FIG. 14.—BIPOLAR OR BRAXTON-HICKS VERSION. POSITION L.O.A.
The index and middle fingers of the left hand, introduced through the cervix, push the head up and along the left wall of the uterus. The external hand depresses the breech until a foot comes within reach.

fingers elevate and push the parts in the direction of the breech. The external hand simultaneously pushes the head toward the pelvis until it lies over the inlet. The membranes are now ruptured, the internal hand is withdrawn, and the head is pushed down and held in place until engagement has occurred. To convert a shoulder into a breech presentation, and this is the more usual procedure, the internal fingers push upward in the direction of the head until a foot can be seized and drawn to the vulva. The proper way to effect delivery in a transverse presentation, in my opinion, is to allow labor to take its course until the membranes rupture. Then Braxton-Hicks' podalic

version is at once performed, unless the cervix has already dilated sufficiently to permit of internal version followed by extraction.

Internal Version.—In order to be practicable, internal version requires a cervical dilatation sufficient to admit the entire hand. If podalic version is to be followed by immediate extraction, the cervix should be completely dilated (see page 456). Cephalic internal version is rarely, if ever, practiced.

INDICATIONS.—Indications are those given for version in general, except

that, in central placenta prævia version will always be called for before the cervix has dilated, and, therefore, bipolar version will be the method of choice, unless the hemorrhage has been controlled by intra-ovular metreurysis until dilatation is advanced (page 540).

Version may be attempted early, if the cervix is sufficiently dilated, the head not firmly engaged, or the shoulders strongly impacted, and the uterus neither tetanically contracted nor the lower uterine segment much thinned out (high contraction ring). Conversely, conditions most favorable to version are a fully dilated cervix, intact membranes, and a presenting part that is unengaged.

TECHNIC.—Lithotomy position (in difficult cases it is preferable to have the legs held by assistants instead of immovably fixed by the legholders), disinfection, catheterization, and careful draping of the abdomen are carried out as in all obstetric operations. Full, in fact especially deep anesthesia, in order to relax the uterus completely, is required. The fetal position and presentation are again verified.

The labia are separated with one hand; the other hand, in cone-

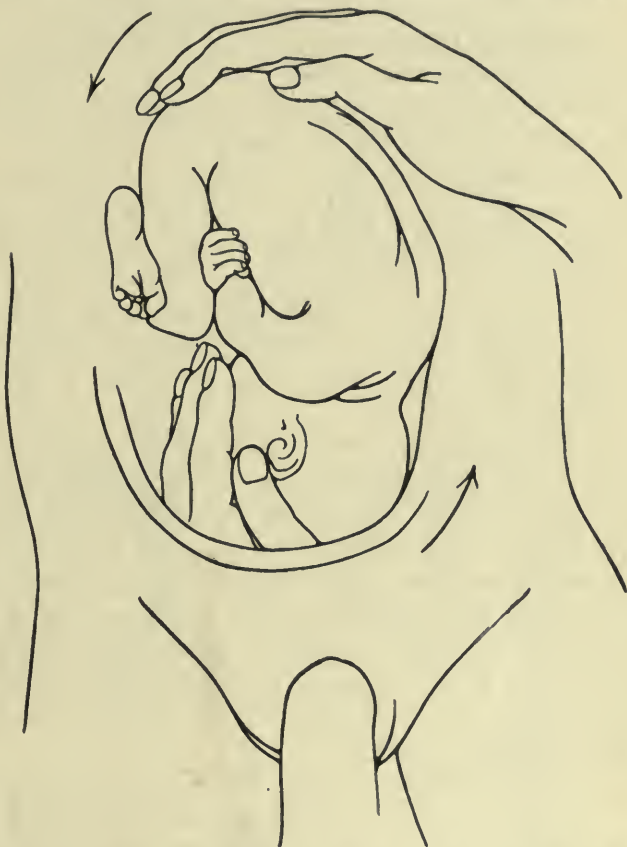


FIG. 15.—INTERNAL VERSION. POSITION L.O.A. The entire left hand (corresponding to the fetal abdomen) has been passed into the uterus and is engaged in passing the head in order to seize the anterior foot. The external hand is depressing the breech.

shape, is slowly introduced by depressing the perineum, and carried far back and upward in the direction of the pelvic canal to the cervix. The external hand steadies and presses down upon the fundus as the internal hand enters the uterus. If the membranes are still intact, they are ruptured, at the level of the cervix, by the fingers, and, undeterred by the sudden gush of amniotic fluid, the open hand is advanced upward, past the presenting part and in close contact with the abdominal wall of the fetus, until the feet are reached, high up near the fundus. One or both feet are seized by the ankles and slowly but steadily drawn

downward and backward. Simultaneously rotation is assisted by the external hand, which first presses down upon the breech, and later, when the head has risen above the pelvic crest, presses the head upward (Fig. 15). The traction on one or both legs is exerted in such a fashion as to favor descent in one of the oblique diameters and to rotate the back of the fetus toward the symphysis. When the foot appears at the vulva, and the head is felt at the fundus, version has been accomplished.

All efforts are suspended during uterine contraction.

Choice of Hand by the Operator.—In easy versions either hand may be employed, because, with plenty of amniotic fluid and a fully relaxed uterus, sufficient space for free movement will be found. Under less favorable conditions the following rules are of service:

In *cephalic presentations* the left hand is preferable for left dorso positions, the right hand for right dorso positions, as these hands will be found to advance most naturally along the abdomen of the fetus, and thus reach the feet with least effort.

In *transverse presentations* the left hand is the better for left scapula positions (L. Sc. A or L. Sc. P), the right for right scapula positions (R. Sc. A or R. Sc. P), because these hands are nearer to the breech (to which the feet correspond).

Choice of Foot to Be Pulled Down.—In difficult versions we frequently must be content to pull down the most accessible foot or knee. Whenever possible, in *cephalic presentations*, the anterior foot is seized, because during extraction the leg which is pulled down always rotates toward the symphysis. In *transverse presentations*, dorso-anterior, the lower leg is drawn down; in dorso-posterior, the upper leg is pulled upon, as this procedure revolves the back of the fetus anteriorly during the turning. Where haste in the extraction is indicated, it may prove of advantage to pull down both legs if the cervix is fully dilated. Otherwise, it is preferable to pull down only one leg, as the half breech is a better dilator.

Difficult Versions.—As the waters drain away and the uterine muscle grasps the fetus more closely, version becomes increasingly difficult and dangerous. If the presenting part is firmly impacted in the pelvis and the lower uterine segment thinned out (contraction ring 5 to 6 cm., 2 to 2¼ in., above the pubes), version is contra-indicated. Not infrequently it requires experience and judgment to determine whether version is still permissible; the beginner should err on the side of safety and resort to craniotomy or decapitation in doubtful cases.

In *cephalic presentations* (face, brow, posterior parietal bone, rarely occiput posterior), the internal hand attempts with gentle force to push the head upward and to pass by the presenting part. Should a firm contraction ring (thick, fleshy, spur-like constriction) be felt above the head, version is contra-indicated. If the head can be passed and the anterior foot can be seized, but the foot cannot be drawn down past the head without the application of undue force, the hand is slowly withdrawn, but again inserted armed with a sling. This sling consists

of a sterile piece of tape 1 yd. long (1 m.) and at least $\frac{1}{2}$ in. (1 cm.) wide, terminating in a slip noose (a 2-in. gauze bandage may be substituted). The noose, steadied by the finger tips, is slipped over the ankle, tightened, and pulled

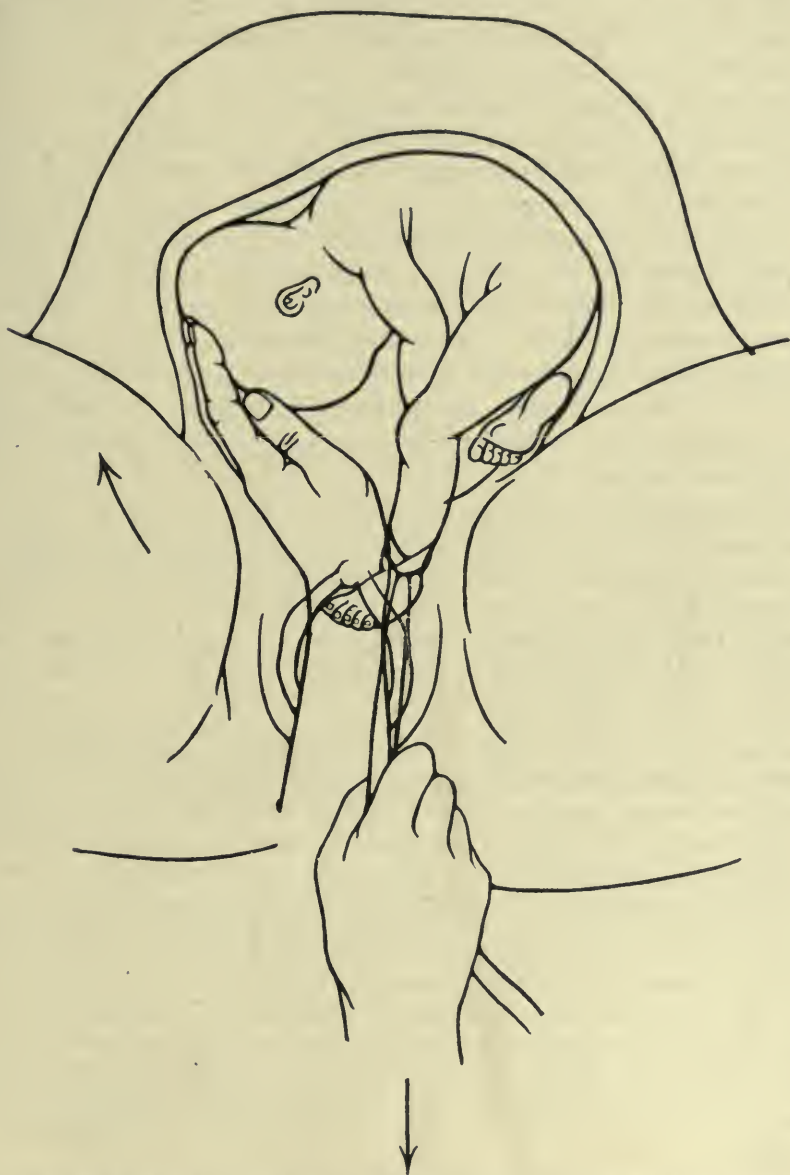


FIG. 16.—COMPLETION OF DIFFICULT INTERNAL VERSION USING THE SLING. A foot could be reached, but the head could not be fully dislodged. Therefore, an ankle was secured by a sling, and rotation assisted by pulling on it. Meanwhile the internal hand is free to guide and push the head upward. Danger of uterine rupture is considerable.

upon in the axis of the birth canal by the external hand. Meanwhile the internal hand is free to push the head upward, an assistant making pressure upon the

breech from the outside. By this maneuver the danger of rupturing the uterus is greatly diminished. The same procedure is likewise indicated even when the foot has been pulled into the vagina if the head refuses to recede readily. If gentle but persistent efforts fail, embryotomy is indicated. A partly engaged head may sometimes be liberated and version facilitated by combining steep Trendelenburg with lithotomy position.

In *transverse presentations*, the impacted shoulder is elevated and pushed toward the head, and a foot (or knee if this is more accessible) is grasped and drawn down. Where undue resistance is met with, the foot may be secured with a sling, and, while the external hand pulls downward on the sling, the shoulder is elevated by the internal hand. Should an arm have prolapsed, it is secured by a sling before version is attempted, and later, during delivery, an assistant pulls lightly on this sling to prevent extension of the arm. No effort is made to replace the arm, as it will be drawn back into the uterus during the course of the version. A prolapsed cord, however, is first replaced, and, if possible, hooked over an arm or shoulder before version is attempted. As in head presentation, combined Trendelenburg and lithotomy position facilitate liberation of an impacted shoulder.

Contra-indications to Version.—If the lower uterine segment is thinned out, a high contraction ring has formed, and the uterus shows tetanic contraction, version almost invariably produces uterine rupture. If the fetus is surely dead, embryotomy is indicated in every case.

Dangers Incident to Version.—Most common is injury to the uterus (rupture). In podalic version the less favorable breech delivery impairs the life chances of the baby somewhat, though to a less degree than (face, etc.) incident to the cephalic posture, for correction of which the version was performed. Premature detachment of the placenta may occur. Infection is favored by the intra-uterine manipulation.

Conduct of Labor After Version.—Unless urgent indications exist primarily, or arise later, the further course is left to the natural forces until the umbilicus is born. Then a breech extraction is done (page 478). If the cervix is not fully dilated, the patient is allowed to awake from her anesthesia, the legholders are removed, she is kept on the table, and all preparations for immediate delivery are kept in readiness. Should the fetal heart sounds grow weak, hemorrhage occur (detachment of the placenta), or the primary indications become more urgent, extraction is proceeded with as soon as the condition of the soft parts (cervix) permits.

After the third stage has terminated, the freshly gloved hands should palpate the vaginal fornices (colporrhæxis) and always be inserted into the uterus (except after external version), exploring the entire internal surface of this organ for evidences of rupture. The treatment of rupture of the uterus is dealt with on page 524. Finally, if no damage has occurred, a hot (120° F., 50° C.) intra-uterine douche of 4 qt. sterile water is given.

UNFAVORABLE POSITIONS AND THEIR CORRECTION

The positions to be discussed are persistent occipitoposterior, brow, and face presentations.

Persistent Occipitoposterior Presentation.—Persistent occipitoposterior presentation rarely necessitates serious intervention. Spontaneous rotation to the

front may take place late in labor, when the occiput reaches the pelvic floor; or the delivery in the occipitosacral position, with consequent severe laceration of the perineum, is not uncommon. Should nature's forces prove insufficient, artificial aid is required.

Early in labor no interference is indicated, except in dry labor, in a primipara. In this case, if the cervix does not dilate, a bag may be introduced in order to hasten dilatation. Later, if the position persists, the following procedures may be tried in both primiparae and multiparae. *In high arrest*, the sinciput may be pressed upward with 2 fingers during pains to increase flexion and favor rotation.

With the head lower in the pelvis manual rotation with 4 or 5 fingers, grasping the occiput and turning it forward (especially if the fetus is small) just anterior to the transverse diameter of the pelvis, is often successful. It should always be preceded by an attempt to increase flexion. The labor may then be terminated with forceps. In no case should we interfere without sufficient evidence of arrest, and until some moulding has occurred.

Brow Presentation.—Brow presentation is a difficult position to deal with if the child is full sized, and becomes impossible of spontaneous delivery if posterior rotation persists. It is fortunate that most brow presentations, occurring early in labor, prove transitory, changing spontaneously into occiput or face during their further course. Should spontaneous correction fail to take place, the brow should be changed to an occiput presentation when possible; if this cannot be done, conversion to a face—if the chin comes anterior—has been advocated, while version is to be considered only if engagement has not yet occurred.

When the condition is recognized early in labor, and it becomes apparent that the deflection is not merely transitory, 2 or more fingers of the internal hand, which correspond to the face of the child, press the brow upward, to increase flexion, while the external hand presses the occiput downward from above. Simultaneously, an assistant presses the breech downward and toward the chin with one hand, at the same time pushing the head and shoulders in the opposite direction. If the lower uterine segment is not too much thinned out, the hand which naturally would grasp the occiput may be inserted through the cervix and pull downward upon the occiput, the external hand pushing the chest in the direction of the fetal back (Thorn's method) (Fig. 17).

Should the malposition persist, version, hebosteotomy, and cesarean section have been advocated; usually craniotomy is indicated.

Face Presentation.—Face presentations require less interference than brow presentations; and, when necessary, intervention should be practiced later in labor. Until the face has reached the pelvic floor, and it has become evident that the chin will not rotate anteriorly, intervention is not indicated. If the chin remains posterior, extension should be favored by pressing upward on the chin, and anterior rotation aided by pulling forward on the posterior malar bone. Not until the chin has rotated forward spontaneously, or has been manually

turned, may forceps be applied to terminate labor, when indications arise. Earlier correction of the malposition is but rarely justified. The methods



FIG. 17.—THORN'S METHOD OF CORRECTING BROW PRESENTATION. The internal hand, corresponding to the occiput, attempts to pull the occiput down. The external hand pushes the chest toward the fetal back. The assistant pushes the breech toward the chin.

used for conversion of a face to an occipital presentation are identical with those described under brow presentation. If delivery cannot be effected, craniotomy is the final resort.

REPOSITION OF PROLAPSED FETAL PARTS AND CORD

Prolapse of Extremities.—The prolapse of an arm, in transverse presentation, requires no separate treatment; it is corrected by version as previously described.

Prolapse of the arm past the head, in cephalic presentation, is often tran-

sitory, occurring before the membranes have ruptured or considerable dilatation has taken place. If persistent, and engagement is not complete, the arm may be manually replaced and retained by placing the patient in the Trendelenburg posture. If engaged together with the head, it is best to wait until dystocia develops, and then deliver the head with forceps, taking care not to include the prolapsed member within the grasp of the blades.

Prolapse of the arms or legs in breech presentation usually assists and simplifies the delivery.

Prolapse of the Cord.—Prolapse of the cord does not endanger the mother, but gravely jeopardizes the child.

IN CEPHALIC PRESENTATIONS.—(1) *If the membranes are still intact* (presenting cord) when the prolapse is noted, knee-chest, Trendelenburg, or elevated Sims position may be tried. In addition the patient should remain prone and not press with the pains. All preparations for immediate interference, after the membranes rupture, must be made, but until this occurs purely expectant treatment is observed.

(2) *If the membranes have ruptured, but the cervix is not fully dilated*, postural treatment should be tried. If this fails, under anesthesia and in Trendelenburg posture, the whole hand is introduced into the vagina, the loop of cord lightly grasped between the thumb, index and middle finger, and replaced as high as possible alongside the head. A metreurynter may then be introduced. Should manual replacement fail, or the cervical dilatation prove insufficient to admit the fingers, a repository may be improvised by arming a thin rectal tube, having a lateral eye, with a stilet (wire). A piece of tape is loosely passed about the cord, a loop of tape formed, passed into the eye of the tube, and made fast by introducing the stilet. By guidance of the finger, the rectal tube is passed through the cervix, along the ventral surface of the fetus, as high as possible, and the stilet withdrawn. The tube is left in place until the head begins to engage. It must be admitted that all the methods described are unsatisfactory. They may, however, tide over the time necessary for fuller dilatation, and must then be followed by immediate measures for delivery.

(3) *If the cervix is dilated*, version, unless contra-indicated, is the best treatment.

If the cord prolapses in front of the head, which has already entered the pelvis, rapid delivery by means of the forceps is indicated.

IN BREECH PRESENTATION the cord should be placed to one or the other sacral hollow and extraction performed as speedily as is consistent with the condition of the cervix.

IN TRANSVERSE PRESENTATION podalic version is indicated.

IF THE CORD NO LONGER PULSATES, the mother's interest alone will guide in the mode of delivery in every instance. Hence, if labor is otherwise normal, no intervention is indicated. If the labor proves difficult, embryotomy should be performed.

After successful reposition, version, etc., the fetal heart sounds must be carefully watched, as necessity for speedy delivery may arise at any time. If the prolapsed cord has passed beyond the vulva, it should be thoroughly irrigated with lukewarm sterile water before attempts at reposition are begun.

OPERATIVE DELIVERY

I. THROUGH THE NATURAL PASSAGES: CONSERVATIVE

- (1) Breech Extraction.
- (2) Forceps Delivery.

(1) BREECH EXTRACTION

Normally a breech delivery requires no interference, though the necessity arises much more frequently than in cephalic presentation. Frequently after version, or when either maternal or fetal indications arise which require more rapid termination of labor, the accoucheur is forced to intervene. Therefore, it is a safe rule in every breech presentation to deliver the patient in the lithotomy position on a table, to prepare the "regular" set, "packing" set, forceps, Clover's crutch, hot and cold bath for resuscitating the baby, aspirating catheters, etc. (page 443); and to have 2 assistants on hand.

Indications.—The indications for breech extraction are partly maternal and partly fetal. Some of them have been discussed in connection with version (page 467). Unless contra-indicated (cervix not fully dilated—especially dangerous in placenta prævia), it is customary, for humanitarian reasons, to terminate every version by extraction at one sitting. There may be urgent reasons for rapid delivery, such as eclampsia, premature detachment of the placenta, pulmonary or heart disease. Dystocia due to weak pains, rigid soft parts, or a large child may necessitate intervention. Fetal indications are most commonly asphyxia, especially the asphyxia resulting from prolapse of the cord.

In breech extraction complete dilatation of the cervix is particularly necessary (see page 455). The membranes must, of course, be ruptured. If the conjugata vera, in a flat pelvis, is below 7 cm. (2 $\frac{4}{5}$ in.), successful delivery is impossible; in a generally contracted pelvis a conjugata vera of 8 cm. (3 $\frac{1}{10}$ in.) is necessary.

Breech extraction naturally divides itself into 3 acts: (1) Extraction of the breech; (2) extraction of the arms and shoulders; (3) extraction of the after-coming head.

1. Extraction of the Breech.—Extraction of the breech should not be practiced unless the special indications, detailed above, arise.

The breech to be extracted may present as a footling presentation (single or double, either spontaneously or as the result of version) or as a complete or simple breech.

SINGLE FOOTLING PRESENTATION.—In single footling presentations the operator grasps the foot above the malleolus, between the index and middle fingers, and pulls it downward and backward in the axis of the birth canal.



FIG. 18.—DELIVERY OF THE BREECH. The index finger of the left hand is slipped into the posterior groin, that of the right into the anterior groin. Delivery is effected by upward flexion.

Too early forward traction impairs descent and may fracture the fetal thigh against the symphysis. Traction is intermittent, being performed during a uterine contraction or while an assistant, whose cupped hands embrace the fundus, presses downward upon the uterus (to prevent extension of the head and arms). If the leg should prove to be the posterior one, it is well to determine the natural course of rotation by passive watching during a pain, or while pressure is made from above, in order that rotation in this direction may be favored, not hindered, during the succeeding tractions. In any case, during succeeding tractions every effort should be made to bring the leg, acting as tractor, anteriorly, in order that the other thigh may not be arrested on the symphysis. As more of the leg and thigh appear, the other hand grasps the limb higher up

and assists in the traction. When the breech reaches the vulva, the index finger of the hand, which naturally faces the child's back, is inserted in the posterior groin, and the breech is delivered by upward flexion (Fig. 18). Throughout these manipulations the exposed portions of the child are kept wrapped in warm (100° F., 38° C.), sterile towels to prevent early respiratory efforts, and to obtain a better hold on the slippery skin surface.

The breech is now grasped with the 2 hands, the thumbs lying parallel to the child's spine, the other fingers along and below the crests of the ilium. Should the fetus straddle the cord, a loop is formed, if possible, and slipped over the anterior leg. When this cannot be done, the cord is doubly clamped, cut between the clamps, and the extraction rapidly terminated. Downward traction is resumed, the back being rotated under the symphysis. Traction is continued until the angles of the scapulæ become visible.

DOUBLE FOOTLING PRESENTATION.—If the presentation is a double footling, both ankles are grasped, the middle finger lying between the ankles. Rotation of the proper thigh anteriorly is encouraged (back toward left, left thigh; back toward right, right thigh). Otherwise, the delivery is identical.

COMPLETE BREECH PRESENTATION.—In complete breech presentation (breech and both feet at same level), if a foot is readily accessible, the anterior foot should be drawn down. This can be accomplished by 2 fingers introduced into the lower uterine segments. When the breech is already engaged in the pelvis, an attempt should be made (provided indication for immediate delivery exists) to hook the index or index and middle fingers of the hand, which naturally faces the abdomen of the fetus, into the anterior groin. If the groin is not accessible, it may be pushed within reach by firm pressure exerted upon the fundus by the assistant. Downward and backward traction is made, the second hand grasping the wrist to aid and intensify the traction. When the posterior groin comes within reach, the second hand is introduced along the fetal back, the index finger hooked into the groin, and traction resumed until the breech is born.

Should these efforts fail, an attempt may be made to pass a sterile, moistened, 2-in. bandage over the anterior or over both groins and to use this as a tractor. Some obstetricians apply forceps to the breech. The best application is in the bitrochanteric diameter. The blunt hook is a dangerous instrument and not to be recommended except when the fetus is dead.

SIMPLE BREECH PRESENTATION.—When the simple breech (extended legs) is above the brim, or not so fully engaged but that it can be freed, the whole hand (choosing the one which naturally faces the fetal abdomen) is introduced until the fingers reach the anterior knee. Flexion at the knee is induced by pressure of the index finger in the popliteal space, the index and middle fingers assisting abduction of the thigh and flexion of the leg until the foot is reached (Fig. 19). The leg is then pulled to the vulva. If the anterior leg is less readily accessible, the posterior one is grasped, and later, during traction, its anterior rotation is assisted.

Extraction of Arms and Shoulders.—As soon as the umbilicus of the child is born, a loop of the cord is pulled down and placed in one of the sacral hollows. Unless the delivery is now completed within from 3 to 7 minutes, a stillbirth



FIG. 19.—BREAKING UP AN IMPACTED BREECH. POSITION S.L.P. The fingers of the internal hand (corresponding to the fetal abdomen) within the uterus press against the popliteal space, simultaneously abducting the thigh and flexing the leg until a foot can be reached.

will result. Therefore, the manipulations to be described must be performed rapidly, though delicately.

When the angles of the scapulæ appear—and these landmarks must be born before the delivery can be effected—pressure from above is stopped. The child's body is raised with the left hand, 2 fingers of the right hand being introduced posteriorly into the vulva.

ARMS FLEXED.—If the arms are found flexed on the chest, the fingers readily sweep the right arm over the fetal abdomen and out of the vulva. The child's body is now supported by the right hand, while a similar maneuver, executed with 2 fingers of the left hand, brings down the left arm of the fetus.

ARMS EXTENDED.—If the arms are extended, the following manipulation

is most effective. To free the left arm, the child's body is raised up and pulled toward the left thigh of the mother, rotating its back to the right. This brings the left arm into the sacral excavation. The operator slips 2 or more fingers of his left hand along the back of the fetus until he reaches the shoulder. The thumb steadies the shoulder, while the index and middle fingers reach the elbow,

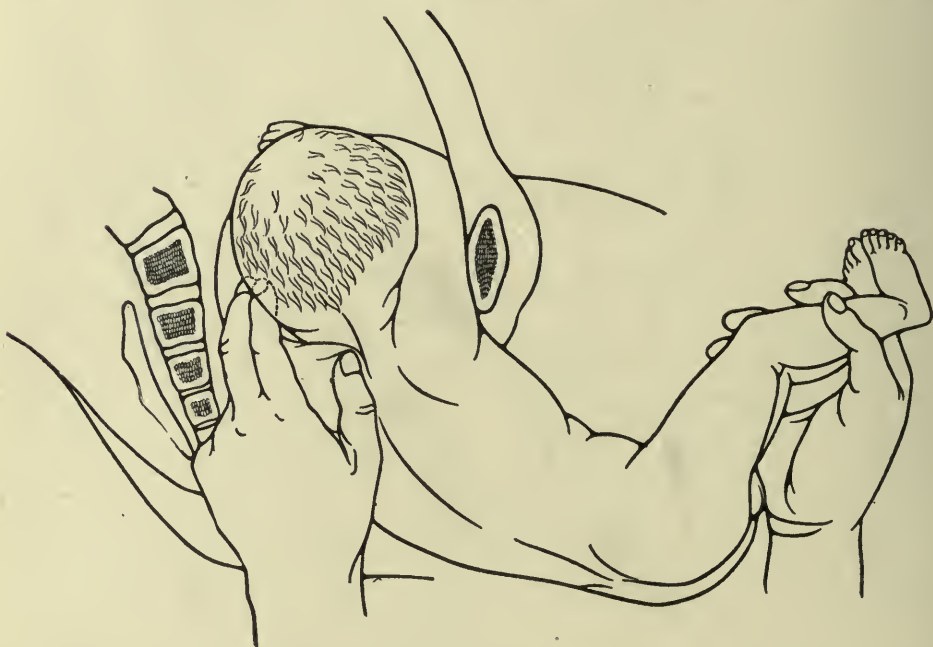


FIG. 20.—BRINGING DOWN EXTENDED ARM IN BREECH PRESENTATION. FREEING LEFT ARM IN HOLLOW OF SACRUM. The body has been born to the scapulae. The back is rotated to the mother's right. The index and middle finger of the left hand press lightly in the region of the elbow joint, the thumb steadying the shoulder. The arm is "wiped down" over the child's face.

and, flexing the forearm, "wipe" it over the child's face and downward along the chest (Fig. 20).

The child's body is now put astraddle of the operator's right forearm. Both hands grasp the thorax, the thumbs lying parallel to the spine, the other fingers encircling the chest. The back is first rotated under the symphysis and then to the opposite side. The right arm is thus in turn brought into the sacral excavation. It is freed by the same maneuver as the left, the operator using his right hand.

Some operators prefer to rotate the body so that the child's abdomen comes anterior. This entails a rotation of $\frac{3}{4}$ of the pelvic circumference. Occasionally, the arm remaining fixed while the thorax rotates, the arm is thus spontaneously "wiped" over the face and more readily freed. Otherwise, the arm is disengaged in a manner similar to the one just described. This method may, however, cause the chin to become fixed above the symphysis.

In France it is customary to deliver the anterior arm. The method is suffi-

ciently explained by Figure 21. If desired, the posterior arm may then be freed in the sacral hollow.

Whichever method is employed, the secret of success lies in freeing the arms before the head enters the pelvis. Therefore, pressure from above must be stopped, and at times the body of the child must be shoved upward, toward the inlet (pushed back into the vulva for a few inches), to facilitate the freeing of the arms.

NUCHAL HITCH.—Very rarely, most commonly as the result of faulty manipulation, 1 or both arms are found flexed at the elbow and wedged behind

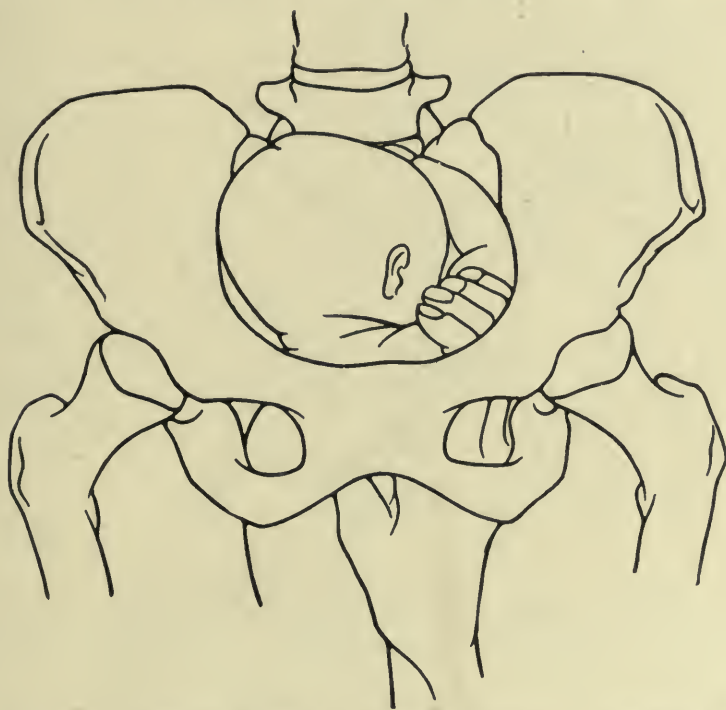


FIG. 21.—BRINGING DOWN EXTENDED ARM IN BREECH PRESENTATION. FREEING ANTERIOR ARM. The fingers of the right hand "wipe" the arm over the face, exerting pressure near the elbow joint (to avoid fracture of the humerus). (Modified from Farabeuf and Varnier.)

the nape of the neck. This complication necessitates introduction of the entire hand, with which the child's arm is raised above the head and swept downward over the face. When this method of correction does not succeed, some accoucheurs deliver the arms together with the head, others have deliberately fractured the humerus in order to free the arm, in preference to obtaining a still-birth.

MÜLLER'S METHOD.—Müller's method of delivering the arms is simple in theory; in practice I have found it unsatisfactory. When the scapulæ are born, Müller increases the downward traction until the anterior shoulder engages under the symphysis. The trunk is then raised and lowered in pendulum

fashion, until first the posterior, and finally the anterior arm is born. (For technic and statistics see Ziegler, 29.)

IN CONTRACTED PELVIS, especially in flat pelvis, the arms should be brought down as soon as the umbilicus appears at the vulva. Introduction of the entire hand will be found necessary to reach the arms.

Extraction of the After-coming Head.—The unmoulded head must be rapidly

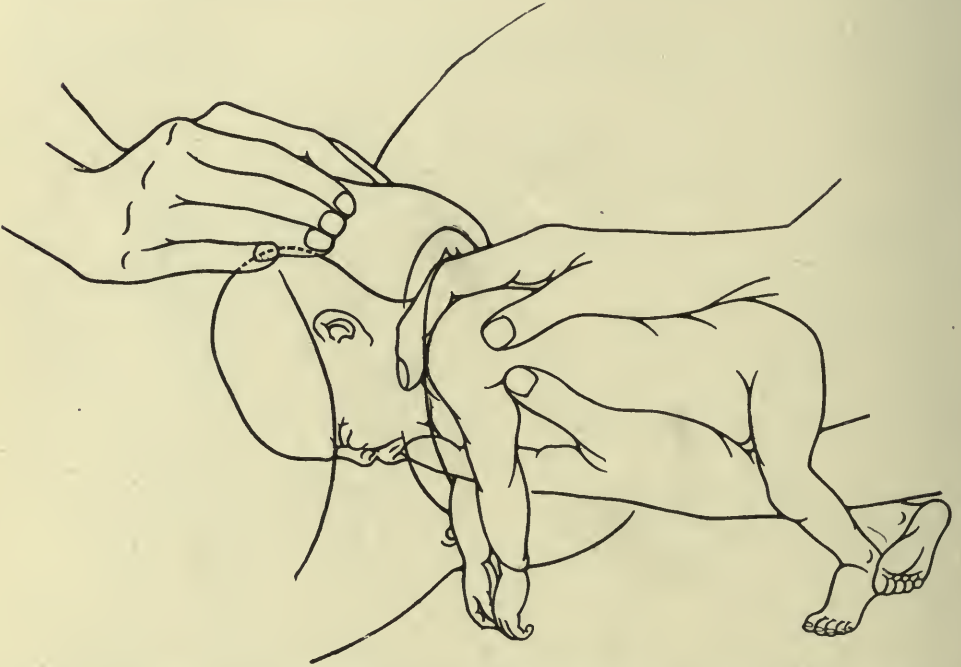


FIG. 22.—DELIVERY OF AFTER-COMING HEAD BY COMBINED SMELLIE-VEIT-WIGAND-MARTIN METHOD.

The chin lies slightly to the right of the sacrum, therefore the left index finger of the operator is introduced into the mouth of the fetus to increase flexion, and to guide the chin directly posteriorly, the palm of the hand and forearm meanwhile supporting its body. The right hand grasps the neck of the fetus, at first pulling downward and backward, later downward and forward. An assistant exerts forcible pressure from above. When the head is arrested higher up in the pelvis, the entire left hand is introduced, the thumb making counter pressure against the lower jaw.

delivered through the pelvis in order to obtain a living child. To accomplish this feat successfully, the smallest circumference must present, and considerable force, either traction with finger in the mouth, pressure from above, or a combination of both, must be employed to bring about complete flexion. The smallest circumference is the suboccipitobregmatic, which presents if flexion is complete. Numerous methods for extraction have been devised. I prefer a combination of the Smellie-Veit and Wigand-Martin maneuvers in all cases in which even slight difficulty is encountered.

WITH BACK ANTERIOR.—After the shoulders are born and the back is anterior, the index and middle fingers of the hand which corresponds to the direction of the fetal chin (left hand if chin points to mother's right), are

introduced into the child's mouth, the thumb steadying the lower jaw from outside the mouth. By means of this leverage, the head is fully flexed upon the chest. The other hand grasps the neck of the child between the index and middle fingers and makes powerful traction downward and backward. Simultaneously the assistant exerts forcible pressure from above upon the occiput, toward the brow, in the direction of the pelvic curve (Fig. 22). With further



FIG. 23.—DELIVERY OF AFTER-COMING HEAD BY REVERSE PRAGUE METHOD. The chin is arrested above the symphysis (extension) and is not within reach. The ankles of the fetus are grasped by the right hand, the neck by the left, and traction is made in the direction of the arrow. The child finally comes to lie on its mother's abdomen.

descent, the occiput is guided into the oblique diameter of the pelvis, and as it reaches the pelvic outlet it is rotated anteriorly and engages under the symphysis. Traction on the shoulder is first made in a horizontal, and finally in an upward direction, the chin, mouth, nose, eyes and forehead being born in succession. As soon as the mouth appears, no further need of haste arises, and the perineum should be guarded by completing the delivery more slowly and cautiously.

WITH BACK POSTERIOR AND HEAD IN FLEXION.—With the back posterior and the head in flexion, the mouth can be reached. A brief attempt to rotate the occiput anteriorly, by means of the finger in the mouth, should be made. If this fails, the reverse Smellie-Veit method is then applicable, the posterior hand making traction on the back and shoulders, the fingers of the anterior hand, inserted in the mouth, assuring flexion. The body of the child is gradually swept in a circle, till it finally rests upon the mother's abdomen. Pressure from above, by the assistant, is a valuable aid.

WITH BACK POSTERIOR AND HEAD DEFLEXED.—With the back posterior and the head deflexed, the chin is not within reach. It may lie above the symphysis. Under these conditions, the reverse Prague maneuver is indicated. The left hand exerts downward traction upon the shoulders, the right hand grasping the ankles of the child, sweeping the entire body upward upon the mother's abdomen, until the occiput is delivered over the perineum (Fig. 23).

EXTRACTION WITH FORCEPS.—Should these methods fail, in either dorso-anterior or posterior positions, forceps may be applied to the after-coming head (see page 500), *provided the head has entered the pelvis*. As the difficulty arises most usually while the head is above the brim, the indications for the application of forceps are limited, and do not frequently arise. If delivery cannot be accomplished before the death of the child, perforation and craniotomy on the after-coming head are to be preferred to forcible extraction.

SPECIAL MEASURES.—Sometimes, in spite of the exercise of all due precautions, the cervix will be found to encircle the child's neck or head. During traction, the rim of the cervix may even appear at the vulva. The cervix may be stripped back by inserting the index finger between it and the fetal head in some cases; in others it becomes necessary to make one or more radial incisions to overcome this obstacle (see page 457).

Should the perineum greatly hamper in extraction of arms or head, a liberal episiotomy incision (especially in primiparæ) will facilitate extraction, and save children which otherwise would be lost, not to mention the avoidance of complete perineal tears.

Breech Extraction in Flat Pelvis.—In delivering a head through a flat pelvis, it will prove of service to encourage a moderate degree of deflexion at the inlet. This deflexion is readily obtained, because, whenever traction is made on the child's body, flexion is interfered with. The resulting position of the head serves to bring the bitemporal diameter opposite the narrowed conjugata vera, the larger biparietal coming to lie near the hollow of the sacrum. The sagittal suture lies in the transverse, which in flat pelvis is commonly longer than usual, and, therefore, can accommodate the occipitofrontal diameter, the largest of all. Under these, the best conditions, the bitemporal diameter is then forced through by exerting pressure alternately upon the anterior and posterior parietal bone from above, the usual traction being made from below. This maneuver corresponds to nature's efforts in effecting engagement in cephalic presentations under similar conditions (asynclitism).

Breech Extraction in Generally Contracted Pelvis.—Extreme flexion must be maintained by the Smellie-Veit method, as this brings the smallest circumference (suboccipitobregmatic) into the inlet.

Post-partum Examination.—After the completion of the third stage of labor, the lower uterine segment, vagina and perineum should be examined for possible injury. After the child has been revived, it should also be examined for evidence of fracture and paralyses (arms, or injury to the spine and skull).

(2) FORCEPS

The forceps is a 2-bladed instrument primarily designed to allow of traction on the fetal head. The left blade, which harbors the lock, is inserted with the left hand, and usually is placed along the left side of the mother's pelvis; the right blade is introduced with the right hand along the right pelvic wall. Each half of the forceps consists of a handle, a shank, and a curved cephalic portion or blade. The blade may be solid or fenestrated. The blade has a *cephalic curve*, corresponding to the curve formed by the side of the fetal head (curve on the flat), and a *pelvic curve* to adapt itself to the curve of the birth passage (curve on the edge). The blades are locked at the shank (Simpson lock by a flange, German lock by a pin, French lock by a screw-pin).

Choice of Instrument.—I prefer the fenestrated Simpson forceps, as modified by the Vienna school, for the low forceps or low medium operation; the Lobensteine modification of the Tarnier axis traction forceps for high or difficult median operations; and the solid-bladed McLane-Tucker forceps for occiput posterior cases, in which rotation within the grasp of the forceps is aimed at. A carefully constructed instrument, made of the best material and obtained from a reliable firm, should always be chosen. Cheap instruments are dangerous. The breaking of a forceps may cause a serious or even fatal mishap.

Indications.—The use of the forceps is indicated to hasten or terminate delivery. The indications for haste may be either maternal or fetal, and may arise from mechanical or non-mechanical causes. De Lee justly says that, in the United States, 75 per cent. of all forceps operations are undertaken because of inefficient pains after the head has reached the perineum, and labor has apparently come to a standstill. In many such cases the use of pituitrin may obviate the need of forceps (page 556).

MATERNAL INDICATIONS.—(A) **MECHANICAL:** (1) Inefficient expulsive force (inertia, exhaustion); (2) increased resistance (rigid soft parts, disproportion due to slight or moderate degrees of pelvic contraction, large child); (3) signs of overdistention or bruising of the lower uterine segment (rising of contraction ring, tenderness of lower abdomen, edema of cervix, vagina and vulva, rise of temperature— 101° to 102° F., 38.3° to 38.8° C.—and a rapid pulse-rate—120 to 130). Under these conditions embryotomy should be the rule,

though a tentative application of forceps may be permissible in experienced hands.

(B) **NON-MECHANICAL:** (1) Systemic diseases with acute symptoms arising during delivery (decompensation of heart, acute pulmonary symptoms, edema, renal insufficiency); (2) intercurrent diseases during labor (as pneumonia or eclampsia); (3) accidental complications (bleeding from prematurely detached placenta or marginal placenta prævia, with head in pelvis); (4) "humanitarian reasons" (exhausted, impatient or hysterical patients). Too often, in this last instance, the pressure brought to bear upon the physician by the patient and family, and nervousness or desire to get away on the part of the accoucheur, rather than any real medical indication, supply the motive. Therefore, only low and easy forceps operations are to be considered, if at all, in this connection, and not until the head has been arrested in mid-pelvis for at least 2 hours (in the second stage with full dilatation), or on the perineum for 1 hour.

FETAL INDICATIONS.—(1) Symptoms of asphyxia (marked irregularity of the fetal heart—variations from 40 or 60 to 160 or 180 beats, or a rate constantly below 100), especially if combined with (2) rapid growth and increasing tension of caput succedaneum and excessive moulding; (3) prolapse of the cord; (4) meconium in the liquor.

Prerequisites.—The prerequisites for forceps operations are most important and must be strictly observed, especially by beginners and inexperienced operators. Every consultant has seen the forceps misused, so that instead of tractors, their effect was that of cervical dilators (deep cervical and parametrial tears resulting), of eranioclasts (stillbirths), or of symphysiotomy or other cutting instruments (rupture of symphysis, vesicovaginal fistulæ, complete perineal tears).

(1) There must be no marked disproportion between pelvis and head—usually a vera not under 7.75 cm. (3 in.) in flat, or 8.5 cm. (3½ in.) in generally contracted pelvis, though in the main the size of the head is the determining factor. (2) The cervix must be effaced and fully dilated (see page 452). (3) The membranes must, of course, be ruptured. (4) The head must be engaged, and, almost without exception, its largest circumference must have passed through the inlet and moulded. (5) The position must be deliverable (not face with chin posterior, brow with face posterior, or posterior parietal bone presentation). (6) The child must presumably be alive.

Contra-indications.—The contra-indications naturally follow from the above, but for emphasis we may formulate them: (1) too great a degree of disproportion; (2) undilated cervix; (3) movable head; (4) undeliverable position; (5) hydrocephalus; (6) dead child.

Position of the Head.—"High forceps" is the designation used when application is made to a head whose largest circumference has not passed the brim—either "floating" if not fixed, or "engaged" if already fixed; "median" or "medium" when the largest circumference is in the pelvic cavity, but not below the interspinous line; and "low" when the head has passed through the bony

outlet. Edgar, with justice, remarks that the gravity of a median forceps largely depends upon whether the cervix is only partly retracted over the head (intra-uterine application) or whether the cervix is fully retracted (vaginal application).

Application of the Forceps.—When the blades are applied with sole regard to their relation with the pelvic wall, and with entire disregard of the position of the head, the application is termed “pelvic”; if applied solely with reference to their relation to the head, it is called “cephalic.” Only if the sagittal suture lies in the anteroposterior diameter of the pelvis do the 2 applications exactly coincide.

Choice of Application.—At the inlet, the head most often lies in the transverse diameter of the pelvis. Under these circumstances a pelvic application (one blade over the occiput, the other over the sinciput) may be the only feasible one. The child is then subjected to severe compression, and the biparietal diameter is increased by the force applied—an unfavorable concomitant. If possible, in transverse position at the inlet, or in deep transverse arrest, an oblique application (one blade over the malar bone, the other behind the opposite ear) should be sought. Whenever the sagittal suture lies in the anteroposterior diameter, or in either oblique diameter, a complete cephalic application (grasping the parietal bones) can be obtained and every effort should be made to get this application.

Technic.—In every case the patient should be delivered on a table, in the lithotomy position, except in difficult high forceps when Waleher’s position is indicated until the head has passed the brim. Disinfection of the vulva, catheterization, anesthesia, draping, and final determination of the position have been previously described (page 443).

The “regular” and “packing” set should be sterilized, likewise one or more pairs of forceps, depending on the nature of the case.

LOW FORCEPS WITH THE HEAD IN THE ANTEROPOSTERIOR DIAMETER OF THE PELVIS.—In the first instance to be considered, the position is occipito-anterior, with the head arrested on the perineum, after the occiput has passed under the symphysis, the sagittal suture lying in the anteroposterior diameter of the pelvis. A cephalic application is desired.

INTRODUCTION AND APPLICATION TO THE HEAD.—The operator, seated or standing in front of the patient, introduces the index and middle fingers of his right hand between the fetal head and left pelvic wall as high as possible. If a rim of cervix is felt, the fingers pass between head and cervix. The handle of the left blade of the forceps is lightly grasped in the left hand, and poised as if it were a pen. The handle is held nearly parallel to the right Poupert’s ligament of the mother, the tip of the blade pointing anteriorly and to the left. The blade is now introduced above the fourchet into the vulva, along the palm of the right hand, keeping the tip close to the fetal head. By means of a sweeping motion, which combines insertion with depression of the handle, the blade is adjusted alongside of the head, coming to lie over the cheek between ear and

eye (Fig. 24). No force should be used, the weight of the forceps sufficing to depress the handle. The handle comes to rest on the perineum, pointing horizontally and slightly to the right. The index and middle fingers of the left hand are in turn introduced between the head and the right pelvic wall, and the right blade grasped and introduced in a similar way.

LOCKING AND TENTATIVE TRACTION.—After introduction, the handles will

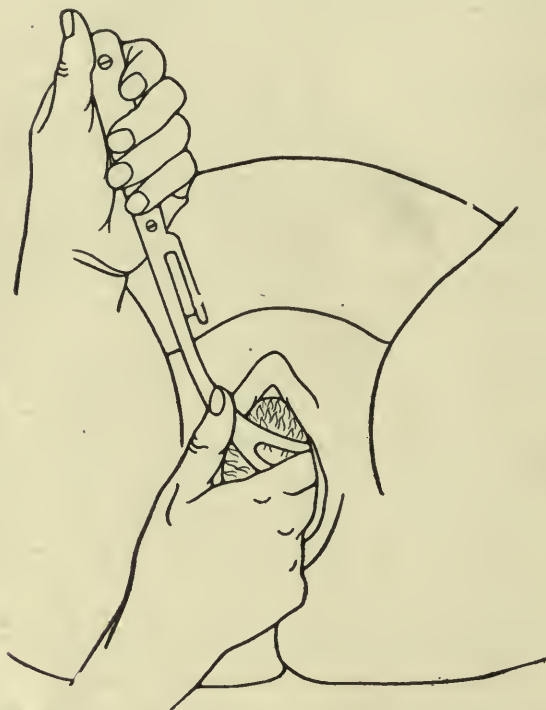


FIG. 24.—INTRODUCTION OF LEFT BLADE OF FORCEPS. The head is on the perineum. The index and middle fingers of the right hand have been passed in between the head and soft parts. The blade is grasped by the handle and carefully introduced between the guarding fingers and the head, the handle describing a wide arc as the blade is pushed upward alongside of the head.

lie crossed but diverging, the right on top of the left. The handles are seized lightly, depressed upon the perineum and rotated outward (or inward) very slightly on their long axis, so that the handles lock and lie parallel (Fig. 25). If the introduction has been correct, very little adjustment is required; if the forceps do not lock readily, their application is faulty, and removal and reapplication become necessary.

When properly locked, the right hand grasps both handles from above, the thumb lying along the lower surface of the handles, holding the handles in close apposition. The fingers of the left hand explore the circumfer-

ence of the fetal head and make sure, beyond any doubt, that neither cervix nor cord is within the grasp of the blades. Thereupon light traction is made downward toward the operator, while the fingers of the left hand rest upon the head and determine that the head is not slipping from between the blades.

TRACTION.—Traction should be made with the pains only, or if there are no uterine contractions, traction should be exerted at regular intervals for 1 minute, with pauses of at least equal length. The beginner will do well to keep his elbows against his chest, so that in case of slipping of the blades or of sudden extrusion of the head no serious damage will result. The power of the arms,

and not the weight of the operator's body, should effect delivery. The direction of pull should be downward and backward until the occiput has passed out from below the symphysis. Then, as the perineum distends, the direction of pull is gradually altered, so that traction is made more and more forward, the handles finally pointing almost parallel to the abdomen of the mother. During their course the handles describe an arc of large circumference (Fig. 26).

REMOVAL OF THE FORCEPS.—When the perineum is well distended, the

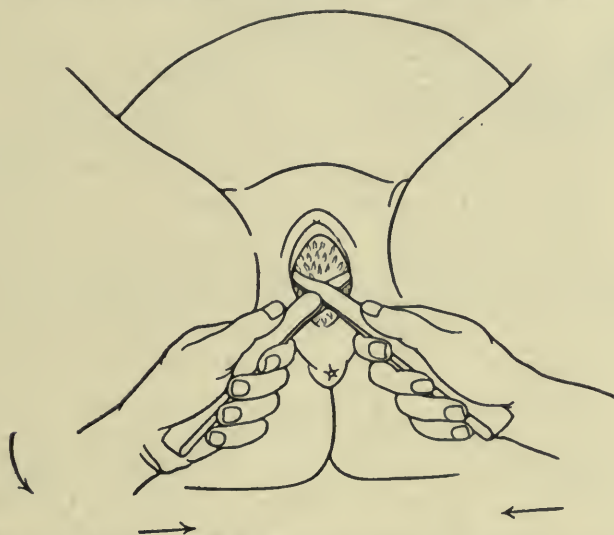


FIG. 25.—ADJUSTMENT AND LOCKING OF FORCEPS. Both blades have been introduced. The right one crosses on top of the left. The handles are grasped and by a complex movement, which combines depression, rotation and approximation, are brought together and locked.

vulva well dilated, and the chin readily controlled through the perineum, it is preferable to remove the forceps and complete delivery in the usual way. The handles are separated, the right blade disengaged from the lock and carefully withdrawn in a manner similar to its introduction. The left blade is then removed. During the removal of the blades, one hand controls the chin through the perineum and prevents sudden expulsion of the head during a pain. The delivery of the head is completed in the usual way by extension, the face being born over the perineum.

Only if the vulvar ring is exceptionally tight, in which case the child's ears are jeopardized by removal, or if the anesthesia proves unsatisfactory, not controlling the mother's expulsive efforts, in which case too rapid expulsion might surprise us, or in occipitosacral extraction, in which better flexion can be maintained, should the head be delivered completely before removing the forceps.

LOW FORCEPS APPLIED TO A HEAD LYING IN THE OBLIQUE DIAMETER OF THE PELVIS.—This differs only slightly from application to a head in the anteroposterior diameter. Let us choose, for example, the left occipito-anterior position. The forceps, when properly applied, will lie in the oblique diameter opposite the one occupied by the sagittal suture. In the left occipito-anterior

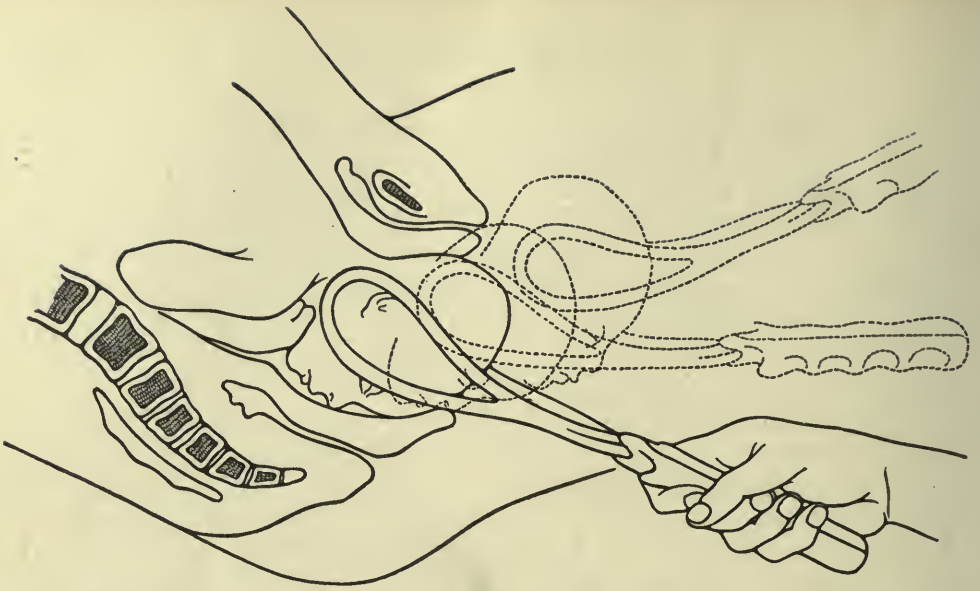


FIG. 26.—DELIVERY, WITH FORCEPS, OF HEAD ON PERINEUM. This figure diagrammatically shows the direction of traction. Until the nape of the neck has engaged under the symphysis traction is made downward and backward. The handles of the forceps are then gradually elevated until the head is born by extension. In the uppermost figure the forceps should be more vertical.

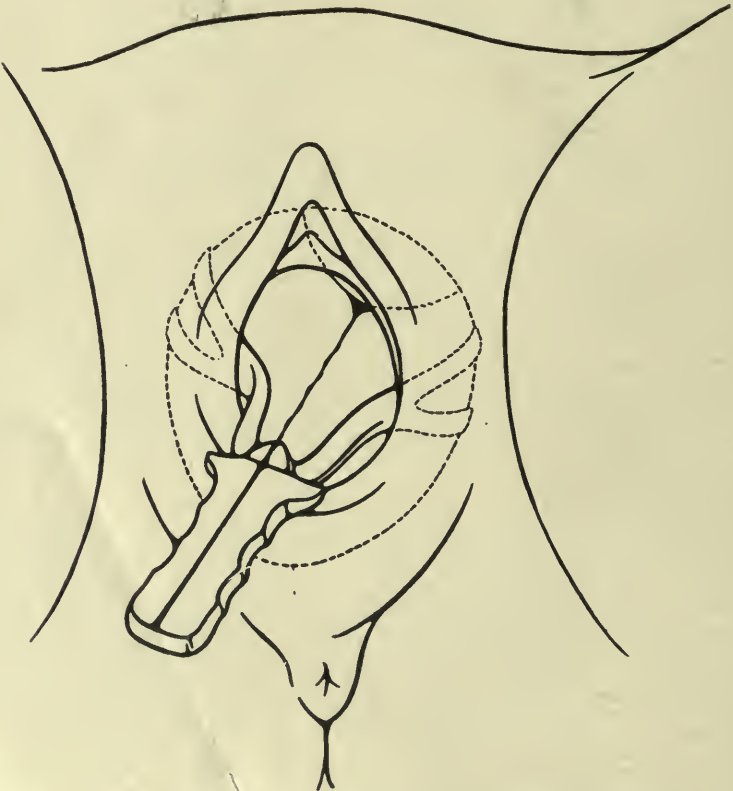


FIG. 27.—FORCEPS APPLIED TO HEAD LYING IN RIGHT OBLIQUE DIAMETER OF THE PELVIS. CEPHALIC APPLICATION TO L.O.A. The handles of the instrument point toward the mother's right thigh. The forceps would lie exactly similar, if the presentation were R.O.P. If anterior rotation of the head were then to take place, the forceps would gradually become "reversed."

position this suture lies in the right oblique diameter; the blades will, therefore, lie in the left oblique diameter (Fig. 27).

The left blade is introduced as described above. It will be found to come to rest slightly more posterior than a blade applied to a head in the occipito-anterior. The right blade is now introduced in turn, as previously described, but, in order to pass around the sinciput and upward around the right parietal bone, its blade must "wander" around $\frac{1}{4}$ of the circumference of the fetal head. To accomplish this movement, without injury to the maternal soft parts, the tip of the blade must be kept close to the fetal head, and no undue force must be exerted. The handle is, therefore, swept in an arc to the left and downward, while the thumb of the operator's right hand, placed beneath the shank and close to the vulva, acts as the fulcrum, the internal fingers of the same hand simultaneously guiding the blade around the head and forward. The handles of the forceps now lie crossed, the blades pointing anteriorly and to the left. The usual amount of adjustment and rotation accomplishes locking, and then traction is begun. During traction it will become apparent that the head gradually rotates into the occipito-anterior position. Delivery is then completed as previously described.

MEDIUM FORCEPS IN ANTEROPOSTERIOR OR OBLIQUE POSITIONS.—If the sagittal suture lies in the anteroposterior or oblique diameter of the pelvis, the application differs but little from that described under the heading of low forceps. Should the dilated cervix not as yet have fully retracted over the head, the tips of the blades will lie within the lower uterine segment. Great care must be exercised not to injure the cervix during application and traction. The internal guiding fingers (preferably 4 fingers, the thumb remaining outside the vulva) must be slipped between fetal head and cervix, and the blade slowly, lightly, and carefully introduced along their palmar surface, until well within the cervical rim. During tractions, the fingers of the left hand are frequently passed around the head, in order to make sure that the cervix is retracting and not caught between the head and the pelvic bones. The anterior lip, in particular, will often have to be pushed upward, otherwise it will be caught and bruised against the symphysis.

OSIANDER'S MANEUVER.—The direction of traction is at first downward and backward. If the occiput does not roll readily under the symphysis, backward traction is increased by pressing with the left hand directly down upon the handles in the region of the lock, while the right hand gently attempts to raise the end of the handles upward (Fig. 28). By these means an axis traction effect is exerted with the simple forceps. It is my custom, whenever a medium forceps proves difficult, to use an axis traction instrument, which greatly facilitates traction in the axis of the pelvic canal.

MEDIUM FORCEPS IN DEEP TRANSVERSE ARREST.—Far more commonly, when the head is arrested in the middle of the pelvic cavity, the sagittal suture lies in the transverse diameter, the occiput pointing either to the right or left (L. O. T. or R. O. T.) and both fontanels being felt at the same level. Appli-

cation of the forceps in this position is difficult. A true cephalic application is not advisable, even if practicable, as this would bring the anterior blade directly behind the symphysis, greatly endangering the integrity of the bladder. The only choice left, unless the pelvic application is employed (provided forceps must be resorted to at this stage) is an oblique application to the head, the one blade applied behind the posterior ear, the other over the anterior malar bone.



FIG. 28.—OSIANDER'S (OR PAJOT'S) MANEUVER. The left hand grasps the handles near the lock and pulls directly backward. The right hand, grasping the handles near their end, pulls downward and forward. The resulting traction corresponds to the direction of the birth canal and produces the effect of an axis traction instrument, though with less efficiency.

Of course the concavity of the pelvic curve of the forceps must point toward the occiput.

To obtain this **oblique application**, in left occipitotransverse, for instance, the left blade is introduced as in occipito-anterior and pushed well over to the left pelvic wall, very nearly as for an application to a head in left occipito-anterior. The right blade is now introduced (while the internal fingers carefully guard the maternal soft parts) along the right pelvic wall, and made to "wander" around the sinciput, till it reaches the right anterior malar bone. To accomplish this, the handles must be swept in a wide arc to the left and downward (Fig. 29). Adjustment and locking will prove more difficult, and **the handles will not come into as close approximation** as they do in a true cephalic application. It is wise to put a folded sterile towel between the handles in order to prevent undue compression during the tractions (Fig. 30).

The concavity of the forceps points forward and to the left. Traction is made downward and backward. As the head descends, it will be found to rotate—the occiput usually rotating anteriorly. As soon as this occurs, unless the

occiput spontaneously rotates in the blades, the forceps are removed and re-applied accurately over the parietal bones as in left occipito-anterior. If the occiput rotates posteriorly, the forceps gradually assume a reverse position, their concavity pointing to the left and posteriorly. Further traction with reversed forceps is sure to injure the soft parts. The blades are, therefore, removed. The further course of delivery will be described under occiput posterior positions (page 498). Some authorities recommend a combination of traction and rotation in order to favor anterior rotation of the head. **Rotation must never be practiced alone; it must always be accompanied by traction.** As this

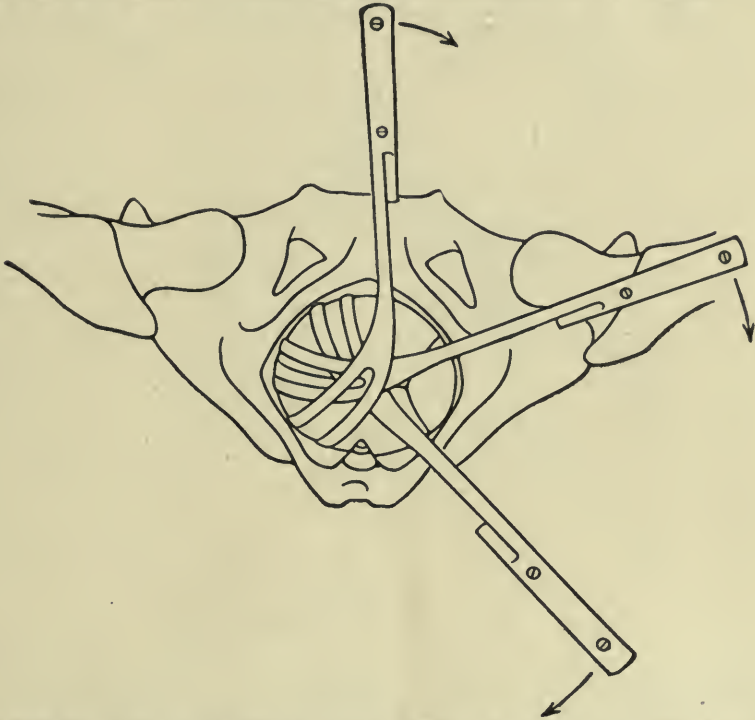


FIG. 29.—“WANDERING” OF RIGHT FORCEPS BLADE. The head presents as L.O.T. An oblique application is desired. For the sake of clearness the left blade, which should already have been applied nearly as in L.O.A. (Figure 27), has been omitted. The right blade is introduced along the right pelvic wall. Its handle is made to describe an arc of large circumference, the fingers of the left hand protecting the soft parts, and carefully guiding the blade around the head until it comes to rest over the anterior malar bone.

combined maneuver is difficult to execute and destructive to the soft parts, I advise against its use.

If the forceps are applied to a head lying in the transverse diameter of the pelvis, an experienced operator will prefer to use an axis traction instrument, because traction backward is more readily obtained, and because the rotation of the head by the pelvic planes is not interfered with. On the other hand, the beginner will find the narrower-bladed McLane-Tucker forceps preferable because it is easier to apply and because, during and between tractions, spontaneous rotation of the head may gradually take place within the grasp of the forceps.

Forceps delivery, in deep transverse arrest, especially in primiparæ, may prove a formidable operation, and should never be undertaken except for grave indications. I prefer, whenever possible, before applying forceps, to encourage flexion and to attempt to rotate the head manually until the occiput lies anteriorly in one of the oblique diameters.

In some cases only a pelvic application can be practiced. As soon as the head has descended and rotated, the forceps are removed and a cephalic application is made.



FIG. 30.—OBLIQUE APPLICATION OF FORCEPS TO HEAD IN L.O.T. COMPLETED. The left blade lies behind the posterior ear; the right blade over the anterior malar bone. The concavity of the pelvic curve is directed toward the occiput. The handles remain widely separated. As soon as the head has been drawn to the perineum and has rotated into the oblique diameter (right oblique L.O.A., favorable; left oblique L.O.P., unfavorable) a cephalic application is made.

HIGH FORCEPS.—Farabeuf and Varnier, in their admirable book, head the chapter dealing with high forceps: "Exceptional and always dangerous application of the forceps to the head arrested at the contracted superior strait." Their warning should receive due heed. The danger is greatly multiplied if the pelvis is at all contracted.

FLOATING HEAD.—The employment of forceps on the "floating head" is a reprehensible operation. The head should be engaged and partly moulded before forceps delivery is attempted. The sole exception would be a multipara with a normal pelvis, dystocia being due to pendulous abdomen, and the time for version having passed. In any case forceps should be tried only tentatively, and if a dozen tractions, at most, fail to show any advance, craniotomy must be

resorted to. The use of an axis traction instrument, except in very easy cases, is almost obligatory. When the ordinary forceps are used, Osiander's maneuver is employed. As "high forceps" is a very serious operation, the indications should be most strictly drawn.

HEAD ENGAGED.—The head, when arrested at the superior strait, usually lies in the transverse diameter of the inlet. Exceptionally urgent indications

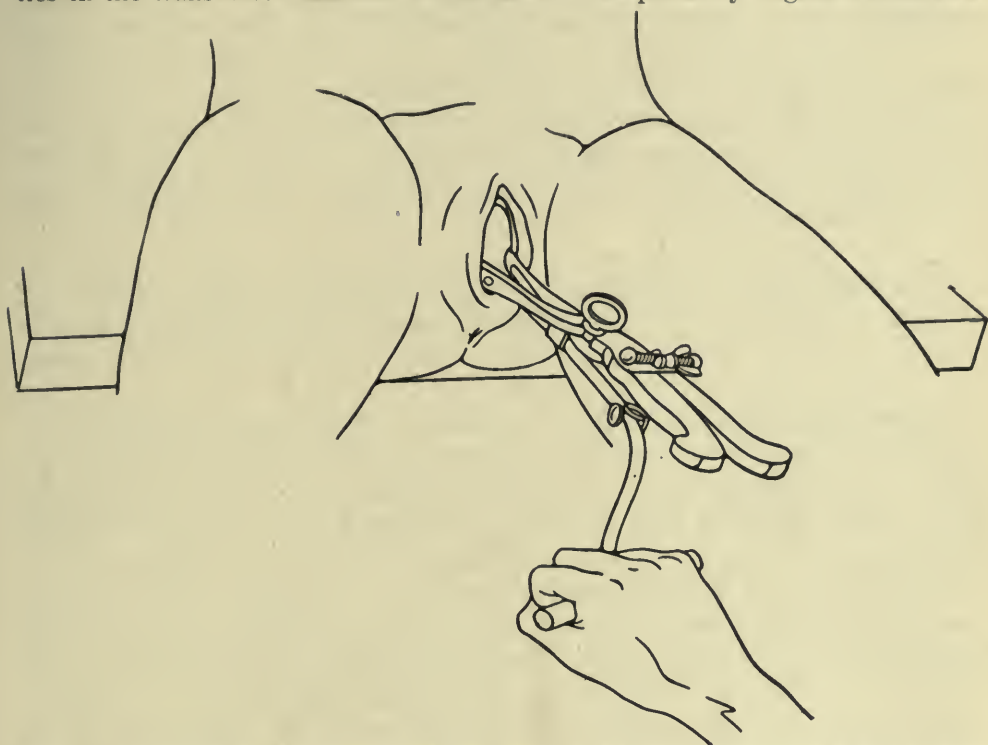


FIG. 31.—AXIS-TRACTION. The patient has been placed in Walcher's position to enlarge the pelvic inlet. The forceps have been applied cephalically. Traction is made downward and backward; the direction of pull being guided by the handles of the forceps. The distal ends of the traction rods should never be separated more than one inch (2.5 cm.) from the handles. When the head has entered the pelvis, the patient should be placed in the lithotomy position.

arise in multiparous women having large pelves (eclampsia, edema of the lungs, premature detachment of the placenta, etc.). In these cases, if the head lies in the oblique diameter, the application, which must then always be cephalic, is more favorable and extraction easier. On the other hand, when the head is in the transverse diameter, the blades come to lie over the occiput and face, compression is severe, and both mother and child are greatly jeopardized.

TECHNIC.—The technic of applying the Tarnier type of instrument is simple. The traction rods are kept locked to the shank and handle during introduction. The entire right hand is inserted into the vagina, the left blade passed along its palm until it is applied over the occiput (in left occipitotransverse), the handle resting heavily upon the depressed perineum. The right blade is similarly introduced over the face, the left hand guiding its introduction. The

blades are articulated by engaging the screw-pin, the handles approximated (not too closely), and the lock tightened. The cross bolt is secured and moderately tightened. A tentative traction shows that the head is firmly grasped. The traction rods are now sprung loose, the traction handle slipped over their fish hook end, and secured by pushing forward the sliding bolt.

The handles of the forceps act as indicators. The direction of pull should be nearly parallel to the handles, an interval of not more than $\frac{1}{2}$ to $\frac{3}{4}$ in. (1.5 to 2 cm.) separating the traction rods from the handles (Fig. 31). If, during the course of the tractions, the head enters the pelvic cavity, frequent examinations should be made to ascertain whether rotation has begun. As soon as the sagittal suture rotates into the oblique diameter, the forceps are removed and reapplied cephalically. The further procedure is that described under median and low forceps.

Some authors, in case forceps delivery fails, and both mother and child are in good condition, advocate hebosteotomy. This method of delivery, especially in primiparæ, entails great danger to the soft parts and does not appeal to me. Craniotomy is far safer for the mother.

Special Applications of Forceps.—**FORCEPS APPLIED TO PERSISTENT OCCIPITOPOSTERIOR POSITIONS.**—In all posterior positions of the head (O. P., M. P., F. P.), the neck must be greatly stretched, and the shoulders enter the pelvic cavity before the head is born. Consequently impaction and arrest are common.

HIGH ARREST.—When the head remains high, it is preferable to attempt manual correction (page 474) should indications arise, and then wait. Before applying forceps in this location, if waiting is contra-indicated, it is advisable to attempt to rotate the head, at least into the transverse diameter, and then to make the application as described under "transverse arrest." Should neither of these attempts succeed, the axis traction instrument is applied cephalically with its concavity pointing toward the sinciput (in R. O. P. or L. O. P.), the head drawn down to the pelvic floor, and, if the occiput does not rotate forward, delivered in the occipitosacral position, after the forehead has engaged under the symphysis.

MEDIUM AND LOW ARREST.—Manual correction is, at times, easier after the head has reached the pelvic floor than when it is higher up. If only partially successful, forceps are applied as in deep transverse arrest (when the head lies in the transverse diameter). If the head lies in the right occipitoposterior or left occipitoposterior, the blades come to lie in the oblique diameter, opposite to the one occupied by the sagittal suture (the tip of the blades pointing toward the sinciput). If, during tractions, the occiput shows a tendency to rotate anteriorly, evidenced by the rotation of the forceps, or recognized by palpation of the sagittal sutures, the forceps are removed as soon as the occiput has moved anterior to the transverse diameter of the pelvis and re-applied as for an anterior position.

If the occiput rotates more posteriorly, and manual correction proves impossible, the forceps are re-applied as if for occipito-anterior, and delivery in the occipitosacral position is effected. The anterior fontanel is drawn under the symphysis, the occiput delivered by extreme flexion maintained by upward traction with the forceps, and the face born by extension. In primiparæ it is usually necessary to perform a deep episiotomy, otherwise a tear, extending into the rectum, may result. It will be observed that I advocate complete delivery of the head without removing the forceps in occipitoposterior delivery.

SCANZONI'S METHOD is largely employed by some accoucheurs; it is a deliberate attempt to produce rotation. The forceps are applied as previously described, as if to an anterior position (for right occipitoposterior, apply as if to left occipito-anterior). But *during* tractions *rotation* is practiced by sweeping the handles in a wide arc to the mother's left in right occipitoposterior, to the right in left occipito-anterior. When the occiput has rotated anteriorly, the forceps have become reversed. They are removed and reapplied facing anteriorly. If the patient is a primipara and the child large, severe and dangerous lacerations are almost sure to result.

Occipitoposterior positions are wearing to the mother, dangerous for the child, and trying to the patience of the accoucheur. The first stage is long and exhausting, especially in primiparæ because early rupture of the membranes is common. Late in labor, the caput succedaneum very often obscures the exact determination of the position, which must then be diagnosed by feeling for the most accessible (posterior) ear. Even experienced obstetricians have mistaken the position under these circumstances. Occasionally it becomes necessary, when the occiput fails to rotate anteriorly, and delivery in the occipitosacral position proves impossible, to perform craniotomy.

FORCEPS IN FACE PRESENTATION.—Forceps should never be applied to a face with the chin posterior. Face presentation is sufficiently rare (about 1 in 200 vertex presentations), and persistent mentoposterior positions form but a small percentage of these. Prolonged waiting is particularly indicated in face presentation. When the face lies in the transverse diameter, and all prerequisites for forceps application exist, but only when forced by grave indications, may an oblique application, as in transverse arrest, be tried. When the chin is directed forward, cephalic application is easier. Before locking the blades the **handles must be elevated** above the horizontal level; otherwise, the child's neck will be compressed. Delivery is effected by downward traction until the chin has passed the outlet and the hyoid region has engaged under the symphysis. The head is then delivered by flexion—the face, brow, vertex and occiput appearing in turn. If the chin remains posterior, some operators attempt to rotate with the forceps. As this method usually proves fatal to the child, and gravely endangers the soft parts of the mother, it is preferable to perform craniotomy at once.

FORCEPS IN BROW PRESENTATION.—Brow presentation is treated accord-

ing to the same principle as the face, as regards the application of forceps, except that the brow forms the point of direction instead of the chin. Consequently, forceps may be used only if the face is directed anteriorly. It is more necessary than in face presentation to make every effort to convert the brow into an occiput presentation manually. Only after these efforts have failed, may forceps be tried. The root of the nose must be drawn down under the symphysis before flexion is brought about. Some authorities, for instance Kerr, warn against any attempt at forceps delivery in brow presentation. They advise manual correction to vertex or face; if this does not succeed, and version is contra-indicated, craniotomy is to be performed without trying forceps delivery.

FORCEPS APPLIED TO THE AFTER-COMING HEAD.—Nearly every text book of Obstetrics advises the obstetrician to have the forceps ready in breech delivery.



FIG. 32.—FORCEPS APPLIED TO AFTER-COMING HEAD. The head is in the pelvis. The child's body is held up by an assistant. The blades have been applied, and the direction of pull is indicated by the arrow.

In practice this instrument is rarely used. Commonly, even in cases in which forceps might properly be applied, attempts to deliver the head by manual methods are persisted in for so long that the child is dead before forceps can be resorted to.

Until the head has entered the pelvic cavity, forceps are contra-indicated. After the head is in the pelvis, if the combined Smellie-Veit-Wigand-Martin or the reverse Prague method fail (page 484), and it becomes apparent that stronger traction is needed, a head lying in the conjugate or either oblique diameter can be rapidly extracted with the forceps, irrespective of whether it is flexed or deflexed (chin above the symphysis).

The child's body and arms are raised by an assistant, the blades applied to the head, beneath the

body of the fetus, and traction—at first downward and backward, later forward—is made (Fig. 32). In some cases, as, for example, with chin anterior and high up, the child's body may be lowered and the forceps introduced in front of the body.

After-treatment.—After every difficult forceps delivery, especially after high forceps extraction, the lower uterine segment, vagina and perineum must

be carefully examined for lacerations and injuries. In doubtful cases a catheter should be introduced to ascertain that the bladder is uninjured.

The child's head should be inspected. Abrasions or wounds are covered with wet dressings (aluminum acetate 0.25 per cent. or boric acid 2 per cent.). Facial paralysis, injuries to the eyes, and fractures or depressions of the cranial vault are looked for. The treatment of these conditions does not, however, fall into the scope of these pages.

II. OPERATIVE DELIVERY THROUGH THE NATURAL PASSAGES: MUTILATING

Embryotomy, though sometimes incorrectly limited to evisceration, properly includes all mutilating operations which aim to reduce the size of the fetus and permit its extraction through the natural passages.

The most commonly performed operations include:

1. Perforation and craniotomy.
2. Decapitation.
3. Evisceration.
4. Cleidotomy.
5. Miscellaneous.

Indications:—DEAD FETUS.—If the fetus is surely dead, embryotomy is indicated when dystocia develops, and is permissible where the operation will save the mother unnecessary pain or injury (prolapsed cord no longer pulsating, after-coming head, small pelvis, malpositions and malpresentations, rigid soft parts, etc.).

LIVE FETUS.—Here the indications should be very strictly drawn, and, whenever possible, the operation should be preceded by a consultation. The wishes of the family should be considered in the choice of procedure, if the physician feels that any latitude is permissible. The parturient herself is, however, never in the proper frame of mind to help in arriving at a decision. In Catholic families embryotomy on the living child may be refused for religious reasons.

1. Monstrosities, hydrocephalus, inextricably interlocked twins warrant the operation. 2. Long protracted labors with absolute dystocia, with the mother in precarious condition (elevated pulse and temperature, thinned lower uterine segment, bruised soft parts), where repeated attempts at delivery have failed, and the fetus is in poor condition, are sufficient indication. Under these circumstances cesarean section or hebosteotomy no longer come into question. 3. Undeliverable positions, such as impacted shoulder, face with chin posterior, or persistent occipitoposterior with a large impacted head, in which measures for correction and extraction have failed and the head is deep in the pelvis, also indicate embryotomy. 4. In contracted pelvis, where the probability of infection contra-indicates cesarean section (membranes ruptured for many hours, repeated examinations), or where the degree of contraction makes hebosteotomy

appear hopeless, embryotomy must likewise be resorted to. In these cases the family should be advised that cesarean section (if the true conjugate is less than 7.5 cm., 3 in.), at the onset of labor, must be arranged for in succeeding pregnancies.

Prerequisites.—The conjugata vera must be at least 6 cm. ($2\frac{3}{10}$ in.) in flat, and 6.5 cm. ($2\frac{1}{2}$ in.) in generally contracted pelves, otherwise cesarean section, in spite of its added dangers, offers a safer mode of delivery. If the case is infected, a Porro-cesarean must be done. Koenig, in v. Winkel's Handbuch, places the lower limits at 5 and 5.5 cm. ($1\frac{9}{10}$ and $2\frac{1}{10}$ in.) respectively. The cervix must show at least 4 fingers' dilatation.

Preparation.—The patient should be placed on a table, anesthetized and arranged in the lithotomy position. The usual measures for disinfection must be taken, the bladder emptied, and, if many previous interferences have preceded, a vaginal douche given (except in cases of after-coming head). The "regular" and "packing" sets, a sterile douche and the appropriate embryotomy instruments must be on hand.

1. Perforation and Craniotomy.—**PERFORATION.**—Smellie's perforator is a straight, pointed, scissor-like instrument, which answers all requirements. In an emergency any strong, pointed scissors will serve. If the head is above the brim it should be steadied and pressed into the inlet by an assistant. Unless the head is thus fixed, the danger of slipping and accidentally perforating the uterus is greatly increased. The scalp may be grasped with a volsellum from below. Most authors recommend perforation at the most accessible spot. I agree with Edgar that, whenever possible, definite locations, varying with the presentation, should be selected. At times the operation will be facilitated by leaving the forceps in situ, if tentative traction has been tried, perforating between the blades; at other times large specula enable the operator to work by sight.

The perforator is introduced along the palm of the vaginal hand, the maternal soft parts being carefully guarded, and by a quick thrust, during which slipping of the instrument must be guarded against, it is pushed into the cranial cavity through one of the flat bones, fontanels or sutures (Fig. 33). The blades are separated to enlarge the opening. The perforator is again closed, rotated through 90 degrees, and re-opened. This establishes a crucial opening. The perforator is now moved about within the cranial cavity to break up the brain, especial care being observed to perforate the tentorium and crush the medulla (to prevent the possibility of crying out and respiratory efforts on the part of the child after delivery). The cranial contents are washed out through the hole by means of the intra-uterine irrigator attached to the douche bag. Projecting fragments of bone are removed with a bone or other forceps.

Whenever possible, the following sites are selected for perforation: in vertex presentations, the occipital bone or small fontanel; in brow and face, through the root of the nose or orbit; in the after-coming head, through the mouth, perforating the hard palate and base of the skull.

Perforation suffices in the case of hydrocephalus, expulsion of the fetus usually following spontaneously. It is preferable, however, for humanitarian reasons to deliver at once. In slighter degrees of dystocia with an after-coming head, labor may sometimes be terminated by traction. Usually, however, craniotomy must at once be performed.

(Some operators prefer a trephine-like perforator to the scissor instrument. The opening must then be made through a flat bone.)

CRANIOTOMY AND EXTRACTION.—The next step consists in crushing the cranial bones to facilitate extraction. In most cases the Braun cranioclast will

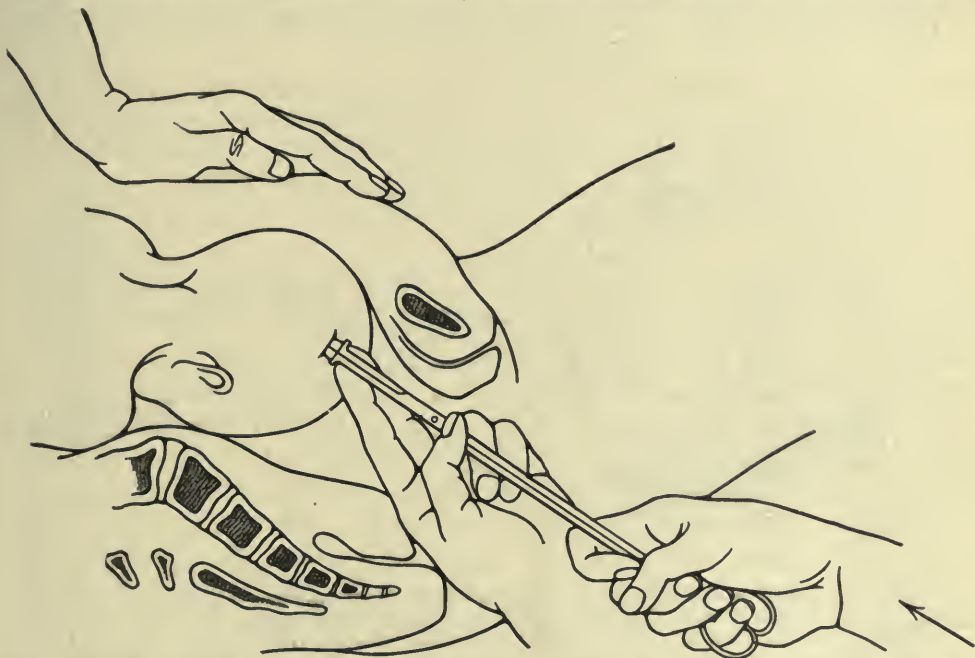


FIG. 33.—PERFORATION. The engaged head is steadied and fixed on the pelvis by forcible pressure exerted from above by an assistant. The operator with his left hand has guarded the introduction of the Smellie perforator and now protects the maternal soft parts as the cutting blades are pushed into the skull.

be found efficient; in greater degrees of contraction, or where this instrument slips, Auvard's 3-bladed cranioclast is employed. Braun's cranioclast is a long, 2-bladed forceps fitted with a compression screw. The solid serrated blade is guided through the perforation opening deeply into the interior of the cranial cavity, and steadied by an assistant. The outer or fenestrated blade is then introduced between the head and maternal soft parts, exactly like a forceps blade, the 2 halves articulated, and, while the soft parts are carefully guarded, the compression screw tightened. As the Braun instrument is designed to be applied along the right pelvic wall, when application is made on the left side, the lock must be turned downward. Should greater comminution be desired, the instrument may be loosened and again compressed over a different diameter

of the head. Before traction is attempted, all projecting splinters of bone must be removed. Where the space is very limited, it may prove of advantage to place the outer blade first.

If the most favorable site for perforation has been selected, the proper mode of application of the cranioclast follows as a matter of course. In vertex presentations the outer blade should lie deeply over the occiput; in brow and face presentations the inner blade should lie along the base of the skull, the outer blade grasping the upper and lower jaws (Fig. 34); applied to the after-coming head the blades should grasp the face.

Extraction is made slowly and carefully in the axis of the birth canal.

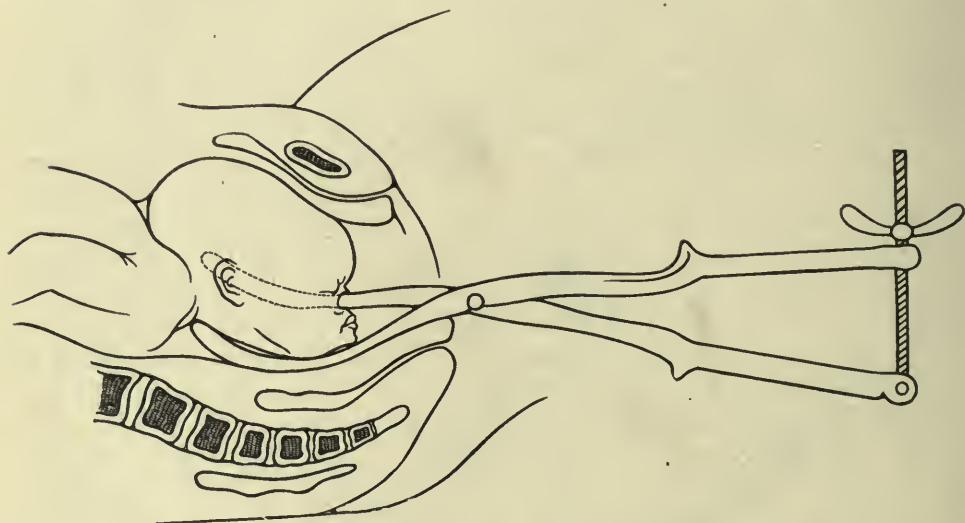


FIG. 34.—APPLICATION OF CRANIOCLAST TO IMPACTED FACE PRESENTATION. CHIN POSTERIOR. Perforation has been performed through the root of the nose and the brain evacuated. The inner (solid) blade of the Braun cranioclast has been passed through the perforation hole; the outer (fenestrated) blade has been applied far down over the chin and neck, the blades locked and the compression screw adjusted. When the latter is tightened, the parts between the blades will be crushed and compressed. Careful traction will then mould the perforated skull, and permit of gradual anterior rotation of the chin. Delivery is then completed with the chin anterior.

Frequent examinations should be made, for the purpose of detecting and removing projecting spicules of bone. The cranioclast should be guided into the middle of the pelvis, and, whenever possible, the most favorable mechanism executed (rotating chin and occiput anteriorly). Sufficient time should be given to allow the collapsed head to elongate gradually and mould itself in conformity with the size and shape of the pelvis. After delivery of the head, cleidotomy and evisceration may have to be practiced. The secret in successfully accomplishing craniotomy and extraction lies in the high application of the blades far over the occiput or over the jaws. Otherwise, in difficult cases, portions of the skull tear off.

Auvard's cranioclast may prove of service where the pelvic contracture is excessive, or where the Braun instrument slips or tears out the cranial bones.

It is a 3-bladed instrument, the outer blades resembling those of a forceps, the inner one entering the perforation hole. The application is more difficult than that of a 2-bladed instrument. The outer blade is applied to the face, and kept in place by the assistant; the central blade is inserted into the cranial cavity, locked with the outer blade, and tightened by the screw; the third blade is passed over the occiput, locked, and compressed against the outer ones. Using all the previously described precautions, delivery is effected. This instrument should be applied so as to lie in one of the oblique diameters of the pelvis. If applied in the transverse, the head, when compressed, enlarges anteroposteriorly, which is undesirable, as the conjugate is usually the most contracted pelvic diameter.

Numerous other instruments are employed by various obstetricians. Those described are the most generally used.

2. Decapitation.—Decapitation is practiced in impacted shoulder presentations. It may also be indicated in interlocked twins or double monsters.

Some modification of the Braun decapitating hook or a strong scissors is employed.

The fetal head is fixed by pressure from above, the prolapsed arm being pulled on from below. In left positions the right hand, in right positions the left hand, is introduced. The thumb encircles the neck from below and in front, the index and middle fingers from behind and above. The Braun hook is pushed up along the palm of the internal hand, anterior to the fetal neck. Its blunt-pointed end is now directed posteriorly and by careful traction embedded in the soft parts of the neck of the fetus, constantly guarded by the encircling fingers. The spinal column is broken by a rotary, cork-screw-like movement imparted through the handle (Fig. 35). Similar rotation severs the remaining soft parts, or these may be cut with a scissors introduced along the hand.

The body is now extracted by pulling on the arm, or the thorax may be seized with a cranioclast and pulled down. At times evisceration will have to be practiced. The decapitated head, after it is ascertained that the spinal column has no projecting spicules of bone, may be delivered by inserting 2 fingers into the mouth and pressing from above. If difficulty is met with, the head may be fixed by volsella perforated and delivered with the cranioclast.

Throughout, care must be taken not to rupture the overdistended lower uterine segment by employing too much force.

3. Evisceration.—Evisceration must be employed in transverse presentations in which the neck is out of reach. A large hole is opened in the chest wall with a heavy scissors, preferably resecting several ribs. The chest contents are evacuated; the diaphragm perforated to empty the abdomen; and when necessary, the spinal column can be severed with a heavy scissors through the chest cavity. The collapsed body can now be extracted and the head delivered as previously described.

4. Cleidotomy.—Cleidotomy, or severing of the clavicles, is practiced to reduce the size of the shoulder girdle. A strong scissors is introduced along-

side the neck, and, while carefully guarding the maternal soft parts, the bone is severed close to the sternum, first on one side, then on the other.



FIG. 35.—DECAPITATION IN IMPACTED SHOULDER PRESENTATION. The prolapsed arm is forcibly drawn downward and away from the head by an assistant. The left hand of the operator has been introduced into the uterus, the index and middle fingers encircling the neck from behind, the thumb from in front. The decapitating hook has been passed along the palm of the hand, guided over the anterior surface of the neck, turned anteroposteriorly, and firmly embedded in the soft parts. The operator's right hand is now ready to break the vertebral column by rotating the handle as indicated by the arrow.

5. **Miscellaneous.**—The solid blade of the cranioclast may be introduced into the anus in impacted breech, the fenestrated blade over the sacrum, to effect delivery.

An after-coming hydrocephalic head may be emptied by tapping the spinal canal with a trochar.

At times various combinations of any of the above described operations are indicated.

III. OPERATIVE DELIVERY THROUGH ARTIFICIAL CHANNELS: CESAREAN SECTION

1. Classical cesarean section (abdominal).
 - a. Without eventration of the uterus.
 - b. With eventration of the uterus.
2. a. Extraperitoneal cesarean section.
 - b. Transperitoneal cesarean section.
3. Porro-cesarean section.

Cesarean section is the term applied to the extraction of the child by way of an incision extending through the abdominal and uterine walls.

Indications.—**ABSOLUTE INDICATIONS.**—Absolute indications arise when cesarean section offers the sole mode of delivery. In such cases the operation may have to be performed though the child is dead and the mother infected.

1. Pelvic contractures of extreme degree (vera under 5.5 to 6.5 cm., 2 1/10 to 2 1/2 in., especially in generally contracted pelvis) render embryotomy more dangerous than cesarean section. 2. Tumors completely blocking the pelvis (bony tumors, adherent ovarian or fibroid tumors), not removable by the vaginal route, and dense stenoses and distortions of the soft parts supply the other indications.

RELATIVE INDICATIONS.—1. Marked degrees of disproportion between fetus and maternal pelvis (vera 6.5 to 9 cm., 2 1/2 to 3 1/2 in.) if the child is in good condition and the mother uninfected. 2. Obstruction to the birth passages (tumors, cervical and vaginal stenosis, carcinoma of cervix, pelvic tumors, uterine fibroids, ovarian growths, very rarely large pelvic exudates, carcinoma of the rectum, dystocia due to vagino- or high ventrofixation).

According to certain authors, there are a number of other relative indications. 3. Eclampsia, if the birth passages are totally unprepared and the symptoms threatening. 4. Central placenta prævia, if the bleeding is severe and the cervix uneffaced and rigid. 5. Premature detachment of the placenta under similar conditions.

Choice of Procedure.—When the indications are absolute, cesarean section should be **prepared for before the onset of labor**, and the operation performed at term, or early in labor. If cesarean section for absolute indications has been performed at a previous pregnancy, labor should not be awaited, because there is considerable danger of rupture of the uterine scar. Should timely interference be neglected, cesarean section becomes an emergency operation. If the mother is still uninfected, the classical operation with conservation of the uterus, and with or without sterilization by tying off the tubes, is indicated; if infected,

the Porro-cesarean operation must be done unless the operator has sufficient faith in the newer methods. (extraperitoneal or transperitoneal) to risk them.

When the indications are relative, the mode of delivery selected must be the operation which offers the best chances to mother and child. If the child is dead, embryotomy should be chosen. In moderate degrees of disproportion, where only slightly more room seems to be required, hebosteotomy (except in primiparæ) is advocated by numerous obstetricians.

If the membranes are ruptured, and physicians or midwives whose technic is at all doubtful have made repeated examinations or attempts at delivery, cesarean section should not be performed. I believe that this rule should be strictly adhered to, in spite of the fact that extraperitoneal or transperitoneal cesarean section has been recommended for these cases. The degree and the severity of the infection cannot be foretold, and in every such instance, the bold and optimistic operator must "trust to luck"—the unfortunate mother paying the death penalty if his guess is wrong. The work of the conscientious pioneers, who are seeking a safe method for cesarean section in infected cases, is to be admired and encouraged, but the profession at large should rigidly adhere to the above rule. Possibly, advances in serum or vaccine therapy will, in time, arm us with a more effective weapon for combating sepsis and peritonitis. Until then, our main efforts should be directed to educating the medical profession and midwives in the proper use of antiseptics and asepsis, and the recognition of serious dystocia early in labor.

If the mother is infected (rapid pulse-rate, rise of temperature, bruised soft parts, dry vulva) or infection is likely, and forceps delivery, correction of malpositions or malpresentations, etc., cannot be practiced, our sole choice rests with embryotomy, even if the child is living. Kerr justly says: "It is always with extreme regret that I perforate a living child. . . . I do not take upon myself the blame of destroying the children; that rests with those who send the cases too late to the hospital."

On the other hand if assistance is lacking, if the surroundings are unfavorable, and the operator is inexperienced in abdominal surgery, he may be obliged to select embryotomy, where, if the opposite conditions obtained, cesarean section would be the method of choice.

Cesarean section, if uncomplicated, is not a difficult operation. Its successful and safe performance, however, presupposes a trained abdominal surgeon, hospital or good home surroundings, and an armamentarium corresponding to that described as "the laparotomy set" (page 434).

If cesarean section is not performed as an emergency operation, the patient should be prepared as for any celiotomy. The time chosen should be at term, or, as some operators prefer, shortly after the onset of labor. In neither case, if the indications are clear, should any vaginal examination be made.

CLASSICAL CESAREAN SECTION

Without Eventration of the Uterus.—Classical cesarean section without eventration of the uterus is a safe operation in clean cases with unruptured membranes, showing a maternal mortality of at most from 1 to 3 per cent. The technic used in the New York Lying-in Hospital, as described by A. B. Davis (3), is ideal for this type.

PREPARATION.—The abdomen and pubes are shaved, the patient is anesthetized with ether, the entire abdomen is scrubbed with soap and water; alcohol and ether are applied, and, as the incision is made, 1 c. c. (15 minims) of aseptic ergot or 2 c. c. (30 minims) of ergotin are given hypodermically. Besides the operator and the anesthetist, 2 assistants and a nurse to hand instruments and sponges are required.

INCISION.—An incision 10 to 12 cm. (4 to 4½ in.) long, slightly to the left of the median line (in order to avoid the falciform ligament of the liver), is made, entirely above the umbilicus. This cut is situated over the fundal region. The various layers of the abdominal wall are raised up and cut through deliberately, one by one, until the peritoneum is opened. It is well to bear in mind that the layers are attenuated at term. The fundus of the uterus presents. The operator's hand now determines, by palpating the fallopian tubes, that the anterior face of the uterus is beneath the incision. If, as usually happens, the uterus lies rotated on its long axis, this rotation is corrected and maintained by lateral pressure exerted from both flanks by the hands of the first assistant, whose sole duty, until the delivery is completed, consists in maintaining close approximation of uterus and parietal peritoneum.

Three moist laparotomy pads are inserted in order to prevent prolapse of intestine and to absorb discharges and blood—1 above, and 1 to either side of the uterus.

UTERINE INCISION.—The uterine incision is now made. It should be strictly in the median line, extending from just below the fundus, downward for 10 cm. (4 in.). The first cut penetrates only through the peritoneum and superficial muscular layer throughout the entire length of the incision. The next may extend 0.5 cm. (¼ in.) deeper. The next cut will be found at some points to reach the mucosa (decidua), or may expose the membranes which protrude under tension. Large, rapidly bleeding sinusses may be caught and ligated, though this is usually unnecessary. By this deliberate incision, should the wound be suddenly flooded with blood and obscured, the operator is in a position to insert his fingers down to the membranes and lightly tear apart the remaining mucosa and muscle without danger of extending the wound beyond desired limits.

EXTRACTION OF THE CHILD.—After the membranes are reached, the operator inserts his entire hand between membranes and uterus and with a few sweeps separates their loose attachment to the uterine wall, avoiding the placental site. If the incision falls directly over the placental site, the bleeding will

be freer, but usually it will be feasible to sweep the hand about, to free the membranes, by detaching the nearest margin of the after-birth; otherwise this step may be omitted and delivery effected through the placenta, as in the vaginal delivery for placenta prævia.

The membranes are ruptured, a foot is seized, and the child extracted by



FIG. 36.—EXTRACTION OF HEAD IN CESAREAN SECTION WITHOUT EVENTRATION OF UTERUS. The small supra-umbilical incision and the hand of the assistant, which presses the uterus against the anterior abdominal wall, are shown. The operator has delivered the child up to the neck, which is encircled by the uterine wound. Delivery may be completed by the Smellie-Veit method.

the breech. The head, when necessary, is delivered by the Smellie-Veit method (Fig. 36). After the head is freed, but not before, the second assistant clamps the cord in 2 places, cuts between these instruments, and removes the child.

The operator reënters the uterus and at once removes the placenta, and its membranes. He then hooks the index fingers of each hand into the upper and lower margins of the uterine wound, raising the uterine to the edge of the abdominal wound. Not until then does the first assistant relax his pressure in the flanks. The assistant now hooks his fingers into the upper and lower angles of the uterine wound, relieving the operator. Should bleeding prove very free, a towel or large packing may be temporarily inserted into the uterus.

SUTURE.—The incision, which has shortened with the contraction of the uterus, is sutured in 2 layers. The deep layer consists of interrupted sutures of No. 2 10-day chromic gut, taking in peritoneum and muscle but not including the mucosa. A suture is first placed at the upper and lower angle to afford

convenient tractors (Fig. 37). Between them, at intervals of 1 cm. ($\frac{1}{2}$ in.), similar sutures are inserted and separately clamped. The sutures enter the peritoneal coat 0.5 cm. ($\frac{1}{4}$ in.) from the wound margin. After all have been placed, any uterine gauze that may have been inserted is removed and the sutures tied, one by one, with moderate tension (3 knots). Starting above the uppermost suture, and ending just below the lowermost one, a running suture of No. 2 plain catgut is placed covering the deep layer. This suture takes in peritoneum and superficial muscle layer, is passed about 1 cm. from the wound edge, and drawn sufficiently tight to bury the deep layer completely. A suture of the Cushing mattress type is less apt to tear out than a simple transverse Lembert suture.

The pads are now removed, the peritoneal toilet completed by sponging

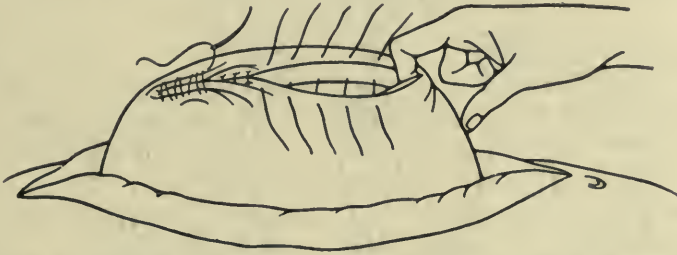


FIG. 37.—CLOSURE OF UTERINE WOUND IN CESAREAN SECTION. The finger of the assistant, hooked into the lower angle of the uterine wound, raises the uterus out of the abdomen. Five untied deep sutures (not extending into the deepest or decidua layer) are shown. To the left of these, three deep sutures have been knotted. At the extreme left the continuous superficial Lembert suture (which covers over the deeper layer) has been started.

away escaped amniotic fluid and blood, and the abdominal wall closed in 3 layers. A light sterile dressing is applied and held in place by a heavy adhesive strap, firmly applied just above the retracted fundus of the uterus (which already lies well below the region of the abdominal incision), in order to further crowd down the uterus toward the pelvis.

With Eventration of the Uterus.—VARIATIONS OF TECHNIC IN CASES WITH RUPTURED MEMBRANES.—If even the slightest suspicion of contamination is entertained, or if the membranes have been ruptured for more than a few hours, it is advisable to modify the technic. Under these circumstances, I consider it preferable to make a large abdominal incision, extending well below the umbilicus, through which the uterus is completely eventrated. The upper portion of the abdominal wound is temporarily closed with volsellum forceps and protected with 3 layers of towels. The lower part of the uterus, where it leaves the abdomen, is also closely surrounded with towels, and not until then is the uterine wall incised and the child delivered (Fig. 38). After suture of the uterus, the surface of this organ is repeatedly washed off with large quantities of hot, sterile salt solution, fresh gloves are donned, the towels removed and changed, and the uterus replaced. Thus danger of contaminating the peritoneal cavity with uterine contents is minimized.

Other Variations.—No advantage is to be gained by slashing incisions, by means of which the abdominal walls are severed with 1 stroke, the uterus opened and delivery effected in 15 to 30 seconds. Injuries to the intestine or to large veins in the broad ligament are likely to occur. Rapid but deliberate operating, such as is practiced by good surgeons elsewhere in the body, is far preferable.

The uterine wound may be closed with a continuous suture placed in 2 or 3

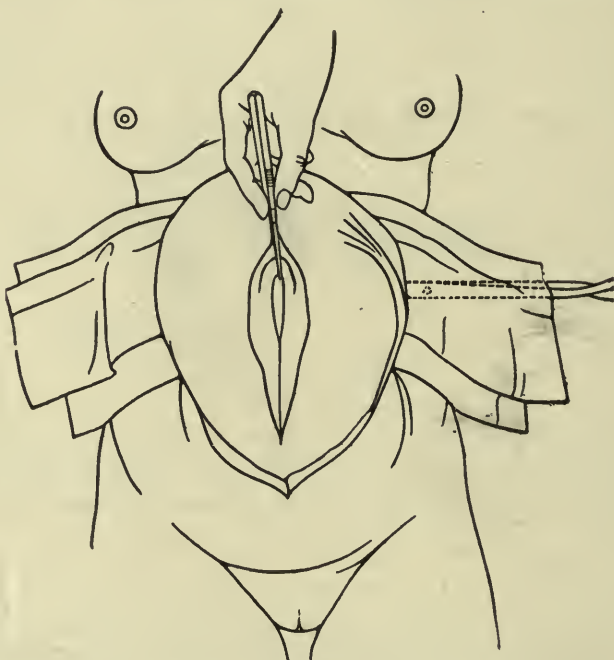


FIG. 38.—CESAREAN SECTION WITH EVENTRATION OF UTERUS. The uterus has been turned out of the abdominal cavity through a large incision. The upper angle of the abdominal wound has been temporarily closed with volsellum forceps. The uterus is surrounded with towels. The illustration shows the uterine incision which, at its deepest part, is just exposing the decidua.

layers. The approximation is more perfect, but the danger of giving way of the suture line and consequent leakage is increased.

The transverse fundal incision of Fritsch offers no advantages. Incisions practiced just above the level of the internal os, on the posterior wall of the uterus (in order to permit of drainage through Douglas' culdesac) have proved disappointing (Polano, 16).

Complications and Accidents.—**ADHESIONS.**—Adhesions, particularly those due to previous cesarean sections, may prove troublesome. If broad adhesions between the uterus and anterior abdominal wall exist, and the general peritoneal cavity cannot be readily entered, it may be advantageous to leave the adhesions undisturbed and to incise the uterus within the adherent area. This renders the operation extraperitoneal and safer. If the uterine scar of the

previous operation can be felt, the new incision should be made through this site, and after delivery its edges should be trimmed away. A new incision parallel to the old, thin scar will result in the giving way of the latter as the sutures are tied. After delivery, the uterine wall and the abdominal parietes are sutured in layers.

Minor degrees of adhesions, intestinal or ventrofixation scars, etc., are treated along general surgical lines. Unless all raw surfaces are covered, the adhesions will at once re-form.

CERVICAL DRAINAGE.—If the cervix is normal, uterine drainage will promptly be established spontaneously, even if the operation was performed before labor. If the cervix is tightly stenosed (pathological stenoses) and a sufficient opening to allow of gauze drainage into the vagina (the gauze is pulled out from below in 36 to 48 hours) cannot be obtained from above during the operation, the uterus must be sacrificed.

HEMORRHAGE.—Atony of the uterus with alarming hemorrhage was formerly of frequent occurrence and necessitated Porro's operation. To-day, the abandoning of the temporary elastic ligature about the cervix and the prophylactic exhibition of ergot just before the abdomen is opened, have almost banished this accident. Should it occur, temporary packing of the uterine cavity, kneading of the fundus and application of hot wet towels will provoke contractions, which are then fortified by another hypodermic injection of some reliable ergot preparation. Uterine contraction may also be stimulated by tying each suture immediately after it has been passed. Injection of adrenalin (10 drops of 1:10,000 solution) into the musculature of the uterus, as advised by some, appears dangerous to me, on account of the possibility of a subsequent increase of the atony. Should all measures fail, amputation of the body of the uterus is indicated. If, after the abdomen has been closed or later during convalescence, uterine hemorrhage is profuse enough to warrant packing from below, the cesarean wound does not contra-indicate this measure.

PERITONITIS may manifest itself within 12 to 24 hours. In some cases it develops late (giving way of a suture). Some authors advise re-laparotomy and free drainage. Usually the condition is hopeless.

After-treatment.—The after-treatment differs but little from that practiced after every laparotomy. The vulva, throughout the puerperium, should be protected with sterile pads. Hypodermics of morphin, gr. $\frac{1}{6}$ to $\frac{1}{4}$ (0.01 to 0.016 gm.), may be given for pain; they are rarely needed for longer than 24 to 36 hours. If involution is slow, fluid extract of ergot, by mouth (15 to 20 drops, 3 times a day), is given after the fourth day. Fowler's position (elevation of the head end of the bed 18 to 24 in., 45 to 60 cm.) may hasten involution and favors drainage; it should, however, not be begun until the patient has recovered from the shock of the operation. The baby may begin to nurse at the breast in 12 hours, if the mother's condition is satisfactory. Throughout the first week the bowels are moved by enemata, the first clyster being given on the third or

fourth day. The diet is limited to fluids until the bowels have been moved. If the convalescence is uncomplicated, the patient is allowed to sit up in bed on the ninth, and to get up on the twelfth or fourteenth day.

Ileus, thrombophlebitis, abscess formation, etc., occurring postoperatively, are treated according to general surgical principles.

Sterilization.—Patients suffering from a serious chronic disease, such as tuberculosis or heart trouble, may be sterilized at the operation. If the section was performed for pelvic contraction, the wishes of the family should be our main guide. The rare occasions at which the cesarean operation is performed for accidental complications (eclampsia, placenta prævia, malpositions) do not justify sterilization.

The method of procedure, except in osteomalacia, in which bilateral oöphorectomy is indicated, consists in tying each tube doubly with fine silk (No. 1), and cutting between the ligatures. The proximal ligature is placed 2 fingers' breadth from the uterine cornu (to avoid the large venous plexuses of the uterine horn), perforating both layers of the mesosalpinx, close to the tube; the distal one is passed 0.5 cm. ($\frac{1}{4}$ in.) away from the first. Only the tube is cut across, otherwise troublesome bleeding may arise from the broad ligament. The ligatures are tied together, which serves to evert the ends, or the uterine end of the tube may be buried between the folds of the broad ligament.

EXTRAPERITONEAL CESAREAN SECTION

Great ingenuity has been shown by certain surgeons who have recently revived and improved older methods for incising the uterus without invading the peritoneal cavity. These operators hoped to effect an approach applicable in doubtful or infected cases. The reports, up to date, must impress the unbiased observer unfavorably, because the danger of peritonitis, though diminished, remains, and equally fatal suppurations in the space of Retzius are frequent. Technically these operations make far greater demands upon the operative skill than the classical cesarean section, injuries to neighboring organs (ureter, bladder) are not uncommon, and the patient cannot be sterilized through these incisions. Of the many methods reported, the following, a condensed description of Döderlein's technic, has been selected.

Technic.—With the patient in the steep Trendelenburg posture, a median or transrectus incision is made, beginning at the symphysis and extending to within 3 or 4 in. of the umbilicus. Careful entrance is made into the space of Retzius (without injury of the peritoneum). The upper border of the bladder and properitoneal fat (with the peritoneal reflection) are bluntly separated, the bladder being pushed downward and toward the median line, the peritoneum upward (Fig. 39). The space is enlarged by bluntly separating the lower uterine segment from the anterior pelvic wall the ureter running transversely toward the bladder, becoming visible in the depth of the wound. If the peritoneum is accidentally opened, the gap is at once sutured. The

thin lower uterine segment is incised sagittally in the median line, the cut being made as long as possible.

The patient's position is now changed to the Fowler position. If the presentation is breech, the child is extracted through the wound by a foot; if the presentation is cephalic, by means of a short straight forceps. The placenta is manually removed. The edges of the uterine wound are seized with small clamps, pulled into view, and closed with a continuous catgut suture. A second layer grasps the surrounding loose tissues and lightly includes the outer coat of the bladder. Layer suture of the abdominal wall follows. In infected cases, drainage through the abdominal wall and through the cervix into the vagina may be practiced.

Mortality.—Tanaguchi (24) has collected 449 extraperitoneal cesarean sections from the literature, showing a maternal mortality of 7.35 per cent., a fetal mortality of 5.9 per cent.

TRANSPERITONEAL CESAREAN SECTION

Transperitoneal cesarean section by various methods has been advocated. Krönig believes that an incision into the thin lower uterine segment, with the wound later protected by the mobilized bladder, is advantageous. Sigwart claims that peritonitis results less often from infected uterine contents, contaminating the peritoneum during operation, than from postoperative seepage from the uterine wound. Moreover, according to this author, the isthmic and cervical segments are least vulnerable to puerperal infection. Finally, the danger of postoperative adhesions is reduced when the bladder can be drawn upward to cover the suture line (Sigwart, 21). Opitz (15) reports 37 cases, of which

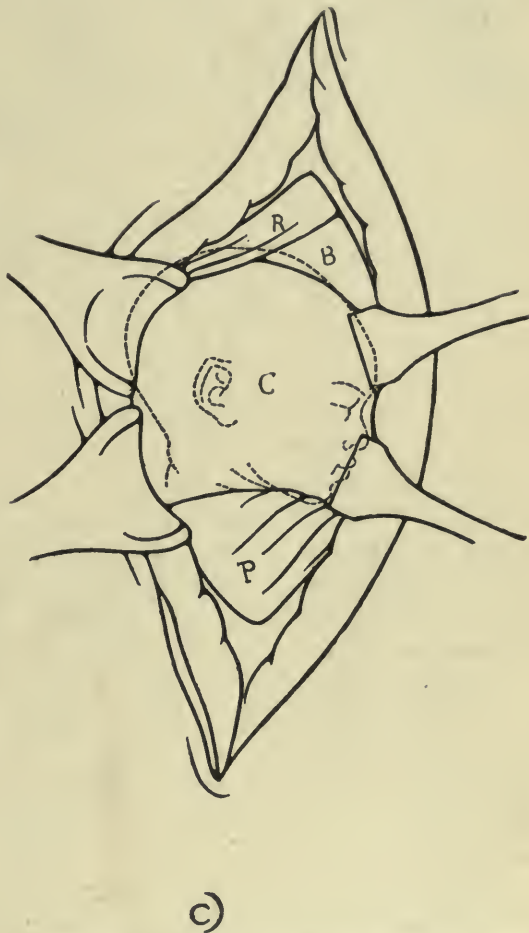


FIG. 39.—EXTRAPERITONEAL CESAREAN SECTION. The relations as they appear after the rectus muscle R is forcibly drawn aside and the bladder B and peritoneum P have been separated, are shown. By proper retraction the cervical segment C has been exposed, the outline of the fetal head being suggested in dotted line. The incision should be longitudinal along a line drawn from B to P. (Modified from Doederlein und Krönig.)

some were badly infected, with a maternal mortality of zero. Frank, Sellheim and recently Hirst unite the parietal and uterine peritoneum before opening the uterus with the hope of preventing the spread of infection to the peritoneal cavity. None of these supposed advantages appears to have been fully realized.

Krönig's Technic.—Median suprapubic incision in steep Trendelenburg posture. Opening of the peritoneal cavity and exposure of the peritoneal reflection over the bladder. Incision of the peritoneum at this site and pushing down

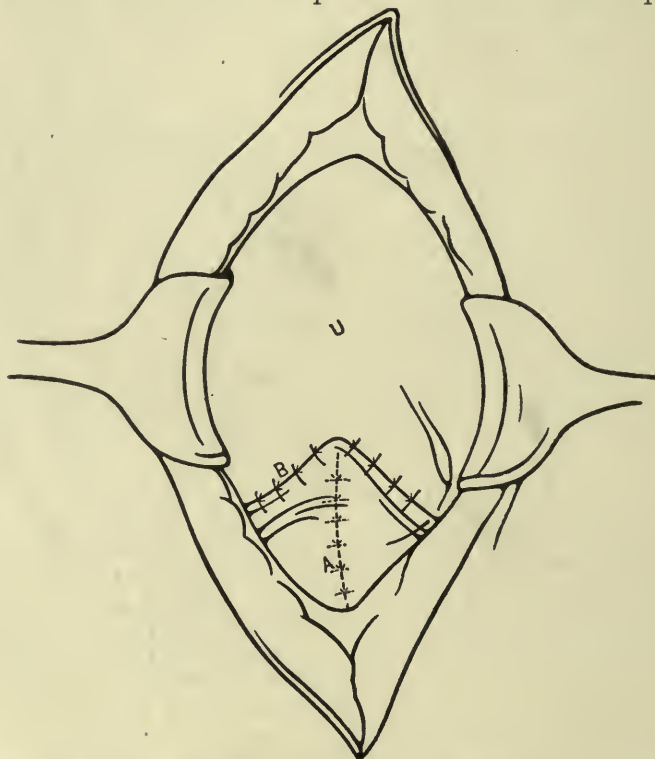


FIG. 40.—REPAIR OF INCISIONS AFTER TRANSPERITONEAL CESAREAN SECTION. A represents the sutured wound in the lower uterine segment through which delivery of the child has been effected; B, the sutures by means of which the bladder is secured in its high position in order to cover and protect the uterine wound. (Modified from Doederlein und Krönig.)

of the bladder (as in hysterectomy). Liberal sagittal incision of lower uterine and cervical segment. Extraction of child (face rotated anteriorly by finger in child's mouth) with special forceps, the concavity of which is directed toward the symphysis. Manual removal of placenta. Running suture of uterine wound. Bladder pulled up and sutured to cover uterine wound completely (Fig. 40). Layer suture of abdomen.

Hirst's Technic.—Median incision through abdominal wall. Shallow cut into anterior surface of uterus; undermining and mobilization of peritoneum surrounding uterine wound. Careful union around entire circumference of parietal and visceral (uterine) peritoneal wound edges by continuous catgut suture (with a knot after every sixth stitch). Incision into uterine cavity

through the artificially extraperitonealized area. Delivery of child and placenta. Suture of uterine musculature and abdominal wall in layers without disturbing the circular peritoneal suture.

Sellheim's Fistula.—Sellheim's fistula for badly infected cases is quite similar except that the parietal peritoneum is sutured to the skin (as in colostomy). The mobilized uterine peritoneum is also sewn to the skin, the uterine cavity opened within the walled-off area, and delivery accomplished. The wound is kept open and drained. Later, if spontaneous closure does not take place, secondary suture of the uterus and abdominal parietes may be attempted.

Krönig's technic may prove hazardous in infected cases. Hirst's technic must fail in infected cases if the thin peritoneal partition sloughs, as it has been found to do in extraperitoneal cesarean section. Technically the transperitoneal operation is simpler than the extraperitoneal method.

PORRO-CESAREAN SECTION

Indications.—Porro-cesarean section (cesarean section followed by hysterectomy) is indicated (1) in infected cases in which absolute indications necessitate cesarean section; (2) where cicatricial stenosis or atresia of cervix and vagina of extreme degree renders the escape of the lochia impossible; (3) in uncontrollable atony and post-partum hemorrhage occurring during cesarean section where other measures have failed; (4) in certain cases of rupture of the uterus (see page 526); (5) in operable carcinoma of the cervix; (6) in the presence of fibroid or other uterine tumors requiring hysterectomy per se.

Technic.—The child is delivered as in classical cesarean section, as varied for cases with ruptured membranes (page 511), the abdominal incision being mainly below the umbilicus. The patient is now placed in the Trendelenburg posture, the contracted uterus seized and raised out of the abdomen, and the pelvis well walled off with pads.

ORIGINAL TECHNIC OF PORRO.—This consisted of transfixation of the cervix with long pins, beneath which a tightly drawn elastic ligature was tied, amputation of the uterine body above the pins, sewing of the cervical stump into the lower angle of the wound, and closure of the peritoneal cavity and upper portion of abdominal wall. This operation has been practically abandoned except in emergency.

The technic described by Kehrer (page 538) for amputation of the uterus in post-partum hemorrhage might well be modified and prove applicable instead of the ligature and pins. In infected cases the stump would have to be left exposed and freely drained.

The hysterectomy is now most usually performed according to the typical technic (Chaps. XII and XIII, Vol. V).

MODERN TECHNIC OF HYSTERECTOMY AFTER CESAREAN SECTION.

—The ovaries and tubes may be removed or not. In pushing back the bladder, great care must be exercised not to injure the large friable veins. The uterine arteries and veins are clamped and ligated close to the cervix (beware of the ureters!), and if the cervix is in good condition, the stump, after amputation of the body, may be closed with a continuous (No. 3) catgut suture. If the cervix is infected, a complete hysterectomy is performed, the vaginal edges carefully surrounded by a quilted catgut suture, and 2 pieces of iodoform gauze led into the vagina (to drain the subperitoneal space). All stumps are peritonealized, the edges of the culdesac of Douglas and bladder peritoneum are united, and the abdominal wall is closed with a layer suture.

In badly infected cases, iodoform gauze may be loosely placed in Douglas' culdesac and led into the vagina either through the open cervical stump or, if this has been removed, directly into the vagina. In such cases only the lateral portions of the bladder and posterior peritoneum are united by suture, a median opening being left for the gauze, which is removed on the fifth to seventh day.

CONCLUSIONS

From what has preceded, it will be readily seen that cesarean section offers a safe means of saving both mother and child in clean cases. But, in spite of the various improvements and modifications, I feel justified in advising the profession at large, especially the occasional operator, not to attempt delivery by cesarean section in any case which has been examined by doubtful fingers, in which labor has been in progress for many hours, or in which repeated attempts at delivery have been made.

TREATMENT OF BIRTH INJURIES

1. Perineal and vaginal tears.
2. Cervical and parametrial tears.
3. Rupture of the uterus.
4. Inversion of the uterus.
5. Associated injuries: hematoma vulvæ, bladder and rectal injuries.

1. PERINEAL AND VAGINAL TEARS

These are the most frequent forms of injury. Almost every primipara sustains at least a tear of the fourchette. If the head is large, the vulva small, the subpubic angle acute, an unfavorable diameter presents (occiput posterior, face, after-coming head), the vulvar ring rigid (old primipara), or the delivery too rapid or instrumental, tears result more frequently and prove more extensive.

SITE OF INJURY

Posterior Wall.—The exterior perineum tears usually in the median line. Within the vulva the line of dehiscence commonly runs along one or both posterior lateral sulci, forming an irregular Y-shaped figure, with the posterior vaginal wall protruding downward as a tongue-like process. Quite often the lower third of the vagina tears, the skin of the perineum remaining intact. This injury may be overlooked unless searched for, because the skin remains uninjured. In so-called "complete tears," the rupture is most often median, extending through the sphincter ani and up into the anterior rectal wall for a variable distance. The middle third of the vagina is rarely torn. The injuries of the upper third are usually continuous with cervical tears (page 523).

Vulva and Anterior Wall.—Injuries of the anterior portion of the vulva show either as abrasions or fissures about the vestibule, or as tears of varying depth, extending mesially or laterally along the urethra and base of the bladder. They are less common and less regular in their distribution than the posterior injuries. When deep, they may extend down to the pubic bone or expose or extend into the bladder. In both anterior and posterior tears the mucous membrane may remain intact, but the fascial and muscular tissues separate. These injuries usually remain unrecognized until the patient gets out of bed.

TREATMENT OF PERINEAL AND VAGINAL TEARS

Prophylactic.—Delivery of the head should be effected slowly. An anesthetic must be given when the perineum distends, and the head "shelled out" between pains, care being taken to effect delivery in extreme flexion or extension (depending on the mechanism). In forceps delivery it may prove of advantage to remove the blades after the head is under control. Whenever the tissues whiten and begin to crack, I prefer to perform an episiotomy (page 462), which limits the injury and places it in a locality favorable for suture. The same practice applies when the vagina begins to tear before the head has fully distended the perineum. The posterior shoulder, unless well controlled, quite frequently produces or extends a tear.

Operative.—After delivery the labia should be separated and the vulva and lower vagina exposed. The time elapsing before the expulsion of the placenta may profitably be employed for this exploration. Should bleeding from above obscure the field, a long strip of gauze may be used to occlude the lower vaginal tube in order to facilitate the exposure. Slight vaginal and perineal tears may be sutured with the patient transversely on the bed (with or without leg-holders); deep or complete tears require lithotomy position on a table. Unless the patient is in shock, immediate repair, after completion of the third stage, is indicated. Under exceptional conditions, a delay of 12 to 24 hours (iodoform gauze packing in the wound) is unavoidable (shock, lack of instruments or assistance). Secondary operations (within a week or 10 days after labor)

though warmly recommended by certain authors, appear dangerous and unsurgical to me.

TECHNIC OF PERINEORRHAPHY.—The instruments included in the “regular” and “packing” set suffice. No anesthetic is required for small tears. When large or complete, anesthesia is advisable (if the delivery was operative, the anesthetic is continued during the perineorrhaphy). For the repair of a complete tear an assistant is needed. If higher segments of the birth passage are injured, these must first be attended to (as packing of uterus, suture of cervix). Within the vagina, or for short external tears, No. 2 10-day chromic gut

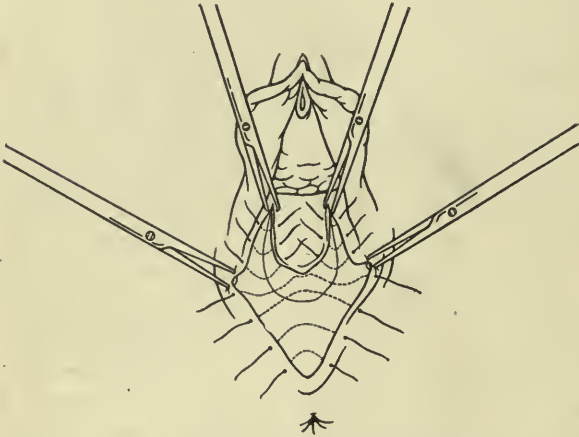


FIG. 41.—SUTURE OF INCOMPLETE TEAR OF PERINEUM. The Y-shaped wound, which consists of bilateral tears of the sulci, and a central perineal tear, has been exposed with volsella. The lower volsella mark the mucocutaneous junction (fourchette). The sutures have been passed but not tied.

is employed. The rectum is best sutured with No. 1 plain, or No. 0 chromic gut. Externally, chromic catgut or medium silk-worm-gut is used.

EXPOSURE OF THE WOUND.—The vagina is plugged with gauze to keep the field clean (a long end is allowed to protrude and thrown upward over the pubes). Clean towels are spread. The sulci are exposed by retracting the anterior vaginal wall with a spade.

The upper angle or angles of the wound are seized with volsellum forceps, and the lower edge (junction of skin and mucosa) similarly marked on each side.

SUTURE OF INCOMPLETE TEARS.—Beginning at or even above the upper angle, sutures of chromic gut are passed transversely at intervals of 1 cm. ($\frac{1}{2}$ in.). The needle enters the mucosa $\frac{1}{2}$ cm. from the wound edge, passes through the musculature and re-appears at the bottom of the tear (careful of rectum!), reënters on the opposite side, and is pushed out at the corresponding part of the mucosa. Each stitch must grasp the lateral structures widely (Fig. 41). When the mucocutaneous junction has been reached, the vaginal sutures, which have been secured with artery forceps, are tied, starting with the upper one. The stitches must not be drawn tightly (to allow for subsequent edema). Care should be taken to prevent pocket formation at the upper angle.

The perineal sutures are then passed, starting at the top. They, likewise, are placed transversely (but horizontally), include considerable tissue laterally, and reach to the depth of the wound. They are loosely tied. Their ends are left long and tied together (especially if of silkworm-gut). Frequently it will be found necessary to place 1 superficial suture at the mucocutaneous junction

and several between the deep perineal stitches in order to prevent inversion of the skin. The vaginal gauze should then be removed.

SUTURE OF COMPLETE TEARS.—The 3 volsellum forceps, previously mentioned, are placed and drawn apart. The upper angle and the 2 lower angles of the rectal mucosa are seized with artery clamps. Starting just *above* the upper angle of the rectal tear, a continuous suture of fine plain or chromic catgut is passed, the suture not entering the lumen of the bowel (similar to a Lembert stitch), but including the rectal musculature (inverting the mucosa into the lumen of the rectum). The suture is continued until the skin is reached (Fig. 42). If the tear is long, the catgut is tied after every fourth stitch. The wound is now thoroughly irrigated and the towels changed. Two subcutaneous mattress sutures of No. 1 chromic gut unite the torn ends of the sphincter ani (which have been seized and drawn out with hemostats) in front of the rectum. The vaginal and perineal tear is now repaired as previously described under incomplete tears (Fig. 43). Before **tying** the perineal stitches, it is my custom to pass a silkworm-gut suture from the skin, through the united sphincter ends, and again out through the skin. This is left in place for 8 to 10 days. After all sutures have been tied, the mucocutaneous junction at the anus should be inspected, and if any raw surface

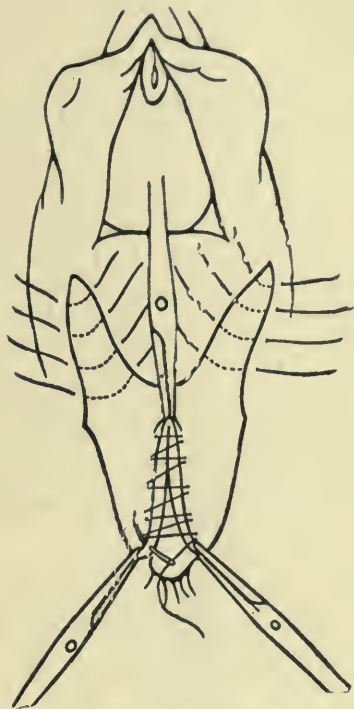


FIG. 42.—SUTURE OF COMPLETE TEAR OF PERINEUM. Three artery forceps demarcate the rectal tear. A continuous Lembert suture is shown, which grasps the muscular coat of the rectum. When this suture is drawn tight, the rectal mucosa is inverted into the lumen of the bowel. The sutures in the lateral sulci have been passed.

remains, this should be obliterated by 1 or more superficial sutures of catgut. A cannula is inserted into the rectum, its end armed with a safety-pin (stuck transversely across the lumen of the tube), and retained by a split compress. The cannula can be improvised by wrapping 2 or 3 turns of iodoform gauze, lubricated with vaselin, around a 3 in. (8 cm.) length of douche bag tubing.

TEARS OF THE ANTERIOR VAGINAL WALL.—Superficial tears of the vestibular region, if bleeding, are closed with interrupted sutures. (See Fig. 11.) Deeper tears are sutured so as to include the retracted lateral structures. Due care must be exercised not to include the urethra or penetrate into the bladder. It is advisable to introduce a large catheter into the bladder as a guide, before passing the sutures.

AFTER-TREATMENT.—The perineal sutures, left long, are passed through a split compress. If the tear is deep and the patient restless, the knees should be kept bound together for 48 hours. Spontaneous urination is permitted. At regular intervals, and also after urinating, the vulva and perineum are irrigated with sterile water and a fresh dry dressing applied. Should redness or swelling develop, a wet dressing of 0.25 per cent. aluminum acetate is substituted (no rubber tissue). The bowels, except in complete tears, are moved on the third morning by means of a mild laxative (cascara), reinforced, if necessary, by an enema. The perineal sutures are removed before they show signs of cutting through, usually on the fifth to seventh day.

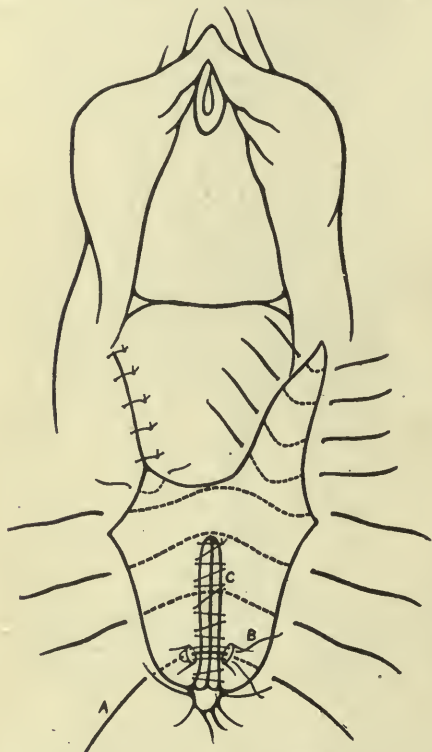


FIG. 43.—SUTURE OF COMPLETE TEAR OF PERINEUM. The lumen of the bowel has been closed by the suture C previously shown in Figure 42. The sphincter ends are approximated by the mattress suture B, and their union reinforced by the through-and-through silk worm gut suture A. The sutures in the right vaginal sulcus have been tied, those in the left sulcus and perineum are ready for tying.

After a complete tear, 10 drops of deodorized tincture of opium are exhibited twice daily for 5 days. The diet is fluid. On the fifth morning, or later if no distention or discomfort develops, 1 oz. (30 c. c.) of castor oil is given. Four hours later, 4 oz. (120 c. c.) of warm olive oil are injected, by means of a small catheter inserted through the cannula, into the rectum, and the cannula plugged. Two hours later a soapsuds enema is given through the cannula. During the ensuing defecation the cannula is expelled. After the toilet of the anus has been completed, a small piece of vaselined gauze is inserted into the anus for $\frac{1}{2}$ in. (1 cm.) after each movement for the next 2 days.

SIGNS OF INFECTION.—Should temperature, chills or local pain develop, the repaired perineum must always be in-

spected. Local tenderness, edema, or pain indicates infection and retention of pus. In every such case, before even considering infection of the higher portion of the genital tract, all sutures should be removed, the wound widely re-opened, and lightly tamponed with iodoform gauze. Many cases of general puerperal sepsis have developed because this precaution has been neglected and the uterus has been tampered with.

"CENTRAL TEARS."—The uncommon "central tears" of the perineum are best treated by simplifying the condition, cutting the vulvar bridge, and then repairing according to the directions previously given (Swift, 23).

2. CERVICAL AND PARAMETRIAL TEARS

Severer degrees of injuries in this region may occur during spontaneous labor if the expulsion is rapid or the parts are rigid or deformed by scars of previous ulcerations or operations. Most commonly such tears result from operative delivery, especially if effected through an incompletely dilated cervix. In this instance they may extend widely into one or both lateral fornices and parametria and run down into the vagina. Exceptionally (attempts at rotation with the forceps) they communicate directly with perineal injuries, or form complete circular tears involving the anterior, posterior and lateral fornices (colporrhexis).

The majority of cervical tears (single, bilateral, stellate) are longitudinal. Occasionally a ring of cervix is torn off. Still more rarely a transverse tear behind the external os develops (this takes place usually in abortion during the earlier months), the fetus being extruded through the false passage. Extreme degrees of tears, when extending upward, are classified as ruptures of the uterus.

If the uterus is well contracted, the perineum well exposed, excluding it as the source of bleeding, and yet arterial hemorrhage persists, a tear of the cervix should be suspected. After every severe operative delivery (high forceps, version, etc.) the entire birth passage must be examined as a matter of routine (after fresh gloves have been donned).

TREATMENT OF CERVICAL AND PARAMETRIAL TEARS

Prophylaxis has been sufficiently discussed under Preparatory Operations (page 452).

Operative Treatment.—Unless hemorrhage develops, cervical tears are not looked for and, therefore, not treated. Hemostasis is effected by suture because packing does not control the bleeding.

The patient is placed in the lithotomy position. Anesthesia is not necessary unless the upper vagina and parametrium are involved. The same instruments as for perineorrhaphy are required.

TECHNIC.—After the placenta has been delivered, by pressing on the fundus or inserting an anterior and posterior spade, the cervix is exposed, seized with 2 ovarian clamps (preferable to volsellum forceps) and pulled into the vulva. In an emergency the cervical lips are easily located by palpation and caught under guidance of the finger. The edges of the tear are exposed, and the upper angle approximated by a through-and-through suture of No. 2 chromic catgut. At intervals of $\frac{1}{2}$ in. (1 cm.), other sutures are passed and tied. The needle should enter and leave about $\frac{1}{4}$ in. (0.5 cm.) from the wound edges (Fig. 44).

Tears extending above the fornix are preferably treated by packing the uterus, suturing only the infravaginal portion of the cervix. Tears of the upper vagina are closed by interrupted sutures. The cervix is likewise sutured, and

an iodoform gauze drain (or larger tampon, if there is much bleeding) passed into the lateral or posterior parametrium through an opening left at the side of the cervix. The uterus and vagina are then tightly tamponed. All the gauze must be removed within 48 hours.

Should bilateral or multiple tears require suture, great care must be exer-



FIG. 44.—SUTURE OF CERVICAL TEAR. The cervix has been pushed into the vulva by external pressure from above, its lips seized with ovarian clamps, and the tear exposed by inserting spades posteriorly and laterally. Four interrupted sutures have been passed (not entering the cervical canal) but not tied.

cised not to narrow or occlude the cervix. Due allowance for the puerperal involutionary contraction must be made.

3. RUPTURE OF THE UTERUS

This accident is one of the most serious that can occur; it is attended by a high mortality.

Varieties.—Rupture may take place spontaneously or as the result of trauma.

1. It rarely occurs during pregnancy (through a previous cesarean section or myomectomy scar, or at the site of a manually detached placenta, musculature eroded by placental villi, etc.).

2. Most often rupture takes place during labor, **spontaneously** (through weakened areas, or from overdistention of the lower uterine segment—small pelvis, transverse presentations, hydrocephalus, malpresentations, ventro- or vagino-fixations, etc.), or **traumatically** during delivery (version, forceps, etc.). Ordinarily rupture of the uterus is synonymous with a mismanaged labor, though exceptionally, when the musculature is diseased, the accident may occur without warning.

Ruptures of the uterus are **incomplete** when the muscle layer is torn, the peritoneum remaining intact. If the peritoneal cavity is opened, the tear is classified as **complete**. Extensive tears of the lower uterine segment (most often longitudinal) may remain incomplete; they are usually characterized by profuse bleeding and are often continuous with cervical tears. Injuries higher up (transverse, oblique) are usually complete, in which case the symptoms of shock may predominate over bleeding. Some ruptures develop more insidiously (latent rupture) and are recognized only by routine digital exploration after operative delivery, or become manifest through the subsequent development of peritonitis. Uterine rupture occurs more frequently in multiparæ than in primiparæ (8 to 1). Rupture may occur repeatedly in the same patient (Becker, 2).

TREATMENT OF RUPTURE OF THE UTERUS

Prophylactic Treatment.—Rupture during pregnancy cannot be forestalled. Spontaneous rupture during labor is avoided by emptying the uterus by appropriate means—version, forceps, craniotomy, cesarean section—before the lower uterine segment becomes overdistended. Danger is evidenced by high contraction ring, restlessness, tenderness of the lower uterine segment, etc. Under such conditions, version in particular is contra-indicated. Severe shock and collapse post partum often signify rupture of the uterus.

Delivery of the Fetus.—If the rupture is discovered before the birth of the child (cessation of pains, in the complete variety; recession of presenting part, collapse, or hemorrhage), delivery should be effected from below by the most rapid and least harmful method—forceps, craniotomy, decapitation—unless the rupture takes place before labor has set in or before the cervical canal is effaced, in which case laparotomy is indicated. In complete tears, if the fetus has been entirely or largely extruded into the abdominal cavity, or in incomplete tears, if the pelvic contracture is so extreme as to render embryotomy difficult, delivery through a laparotomy incision is preferable.

Non-operative Treatment, Post Partum.—This treatment has given excellent results, especially in the incomplete variety. When the facilities at hand are limited, it becomes the sole method available.

The site and extent of the injury are ascertained by manual exploration (under anesthesia, if the condition of the patient permits this). After the diagnosis is assured, the cervix is seized as if for trachelorrhaphy. Prolapsed viscera (intestine, omentum) are carefully replaced through the uterine rent, in the complete variety. The entire uterus and vagina are then firmly packed with long strips of 5 per cent. iodoform gauze at least 6 in. (15 cm.) in width, knotted together. When the tear of the lower uterine segment has extended into the lateral parametria (broad ligaments), the effort is made to control the profuse hemorrhage not only by packing the uterus, but also by inserting liberal quantities of gauze firmly into the enormous lateral cavity. Firm tam-

ponade of the vagina and counterpressure from above (first manual, later by pads held in place by a binder) supplement the hemostasis.

After-treatment.—The patient must be minutely watched for symptoms of beginning peritonitis (distention, vomiting, increase in pulse-rate unaccompanied by increasing pallor, abdominal tenderness). Should these signs develop early, hysterectomy, with liberal drainage through the vagina, is indicated as soon as the primary shock has passed off. Signs of continued hemorrhage may likewise demand radical measures (laparotomy with suture of tear, or hysterectomy). In almost every instance of uterine rupture the shock and loss of blood require energetic after-treatment (intravenous, subcutaneous and rectal infusions; shock blocks; bandaging of limbs alternately for 1 hour; hypodermic stimulation). Morphin is the sovereign remedy for the shock (gr. $\frac{1}{4}$, 0.016 gm.). It is given hypodermically whenever the patient shows restlessness.

The tampons are left in place for from 48 to 60 hours. Patients suffering from uterine rupture must be watched by relays of physicians for several days, unless they are placed under hospital supervision.

Operative Treatment.—Operation is indicated in incomplete tears in which the fetus cannot be delivered from below, or the bleeding controlled by packing. It is also called for when the entire fetus has been born into the peritoneal cavity, or when delivery through the natural channels can be effected only at the cost of greatly increasing the rent. Tears involving other organs likewise demand laparotomy.

Under these circumstances, the patients do not bear operative interference well. They are ordinarily in collapse or profoundly shocked from the preceding protracted labor, the transportation to the hospital (if home surroundings make this necessary), and the loss of blood. Rapid and not too radical work will give better results than careful preparation and complete operation.

TECHNIC.—The abdomen is shaved dry, and painted with tincture of iodine (15 per cent.). Under light ether anesthesia a large median, suprapubic incision is made. The intestine is packed off. The child, together with the placenta, is then delivered from the peritoneal cavity, through the rent if necessary. Suture of the tear follows, after ragged edges have been cut away. Either interrupted or continuous suture of catgut, as in cesarean section, may be used. When the case is badly infected or the rent is complicated, amputation of the uterus, with gauze drainage through the cervical stump, cannot be avoided at times. Should the patient's condition prove desperate, it is preferable to risk the danger of subsequent infection, than the more immediate certainty of death from shock. Many lives have been lost by not following this rule.

Lateral tears, sometimes incomplete, accompanied by profuse hemorrhage (not controllable from the vagina), and complicated by enormous retroperitoneal hematoma formation, may necessitate supravaginal amputation of the uterus. The hematoma is then laid open, the clots evacuated, bleeding vessels caught (this is not always possible) and the cavity packed with gauze. When feasible, the peritoneum should be sutured over the gauze, the tampon being led

out through the open cervical stump. As a general rule, patients who have once had rupture of the uterus should not be permitted to become pregnant again.

The after-treatment is similar to that following cesarean section, and rupture of the uterus treated by non-operative measures.

Colporrhexis—longitudinal or circular tears of the fornices—is also treated by tamponade. This variety of tear usually results from direct injury (forceps-blade) or when the uterus has been fixed (ventro- or vaginofixations) or displaced (pendulous abdomen), or in neglected transverse presentations.

4. INVERSION OF THE UTERUS

This accident occurs during or after the third stage of labor. It frequently results from overforceful or unskilled use of Credé's method of expressing the placenta, or traction exerted upon the cord. More rarely it occurs as a result of manual extraction of the placenta. Irregular uterine contractions may produce the inversion spontaneously, even late in the puerperium. The inversion may be complete or partial. The accident is recognized by the absence of the fundus, the presence of a funnel at or above the cervical site (by abdominal palpation) and a fleshy tumor occupying the vagina or appearing at or beyond the vulva. If the onset is acute, shock and hemorrhage may prove fatal. In neglected cases the body of the uterus may be strangulated and slough off; more often fatal infection develops.

Treatment.—When recognized, immediate reposition is indicated under deep anesthesia. The placenta, if still attached, is removed, and the exposed organ irrigated with sterile water. The tumor is grasped in the palm of the hand, and gradually (by exerting pressure first on one side, then on the other) is crowded back through the cervical ring. Indentation of the fundus is less effective. The cervix may require manual dilatation before reposition is possible. A temporary expedient, until help arrives, consists in replacing the inverted organ into the vagina, and packing the vaginal tube firmly. In neglected cases reposition may prove impossible. Gradual reposition by a combination of Trendelenburg's posture, colpeuryesis or gauze packing may succeed. The cervical ring and lower uterine segment may be split posteriorly (Küstner's operation), inversion effected and the incision sutured. Rarely vaginal hysterectomy has to be performed.

After replacement of an acute inversion, the uterus and vagina are firmly tamponed with gauze and ergot exhibited. During the puerperium a recurrence must be guarded against.

5. ASSOCIATED LESIONS

Hematoma of the Vulva.—Hematoma of the vulva may occur in pregnancy, during or after labor. When the accumulation of blood is large, it may produce

signs of general anemia. The coverings of the mass may rupture, or infection and abscess formation develop.

Only if the accumulation is large or obstructs delivery, are incision, shelling out of the clots, and hemostasis by ligation or gauze packing indicated. The incision should be located in the labium, as far from the vulvar orifice as possible. Small hematomata are controlled by vaginal and external pressure. Vaginal and subperitoneal hematomata have been described; when large and causing anemia, incision and packing are indicated. All such patients must be kept under careful supervision and watched for signs of internal hemorrhage for at least 24 hours.

Separation of the Symphysis.—Separation of the symphysis during labor is uncommon. If spontaneous and uncomplicated, strapping of the pelvic girdle and rest in bed suffice. When due to brutal or unskillful operative delivery (usually forceps), associated injuries of the soft parts—tears of urethra, bladder, etc.—produce a compound wound, which requires abundant gauze drainage. The further after-treatment then corresponds to that of vesicovaginal fistula, etc. (Tuley, 25).

Vesical, Urethral, and Ureteral Injuries.—Vesical, urethral, and ureteral injuries become manifest at once if due to tears occurring during delivery, or appear 2 to 5 days post partum when due to pressure necrosis. Leakage of urine is the only distinctive symptom. This may at first be masked by the profuse bleeding which accompanies extensive injuries. Our sole care should be to establish and maintain free drainage. Perforating injuries of the bladder, communicating with the peritoneal cavity, however, require laparotomy and suture (Vol. IV, page 725). The repair of the other injuries cannot be attempted until all sloughs have been cast off, and is preferably postponed for 2 to 3 months post partum.

Rectovaginal Fistulæ.—Rectovaginal fistulæ, if due to pressure necrosis, develop after 4 or 5 days. They cannot be repaired until all sloughs have disappeared. Frequent, weak, antiseptic, vaginal douches (bichlorid 1:10,000, or lysol $\frac{1}{2}$ per cent.) are ordered. Injuries due to lacerations produced by improperly applied forceps blades may be sutured in 2 layers (as in complete tears of the perineum) if the edges are not much lacerated. Otherwise, their repair must be postponed for several months.

OPERATIONS FOR TUMORS OF THE PELVIC ORGANS AND BIRTH PASSAGES DURING PREGNANCY, LABOR AND THE PUERPERIUM

1. Fibromyomata.
2. Carcinoma of cervix.
3. Ovarian growths.
4. Tumors of the vagina, vulva and pelvic bones.

1. FIBROMYOMATA

Fibroids may, but rarely do, cause disturbance during pregnancy and labor. In large series of cases from maternity hospitals, fibroids are found in from 0.7 to 1 per cent., yet they require interference in less than 0.02 per cent.

Complications Due to Fibromyomata.—DURING PREGNANCY they may cause abortion, overdistention of the abdomen from rapid growth, pain, fever and peritonitic symptoms from necrosis, incarceration, twisting of their pedicle or degeneration (Ihm, E., 10).

DURING LABOR fibroids remaining incarcerated in the pelvis (pedunculated, intraligamentous, cervical or adherent) may produce dystocia. Fundal growths cause no trouble; those of the intermediate and lower zone are usually drawn out of the pelvis by the retracting musculature. Malpositions and presentations are, however, favored, and placenta prævia is unusually frequent.

POST PARTUM, adherence or retention of the placenta, profuse bleeding or inversion of the uterus may result.

DURING THE PUERPERIUM infection and necrosis of the growths (due to bruising, too rapid involution), spontaneous expulsion through the cervix (in the submucous variety), mechanical interference with uterine drainage, thrombophlebitis, and sepsis have been noted.

In spite of this formidable array of possible complications, we repeat, intervention is but rarely called for.

Treatment During Pregnancy.—Early abortion is treated as usual. Curettage is to be avoided as it favors necrosis and infection of the fibroids. Massive growths which already fill the entire abdomen, before the fifth or sixth month has been reached, demand abdominal hysterectomy unless the tumors are single. If solitary, abdominal myomectomy with or without termination of the pregnancy is indicated. If the uterine cavity has to be widely opened in order to enucleate the tumor, the fetus and placenta should be removed, gauze drawn through the cervix, and the uterine wound closed in layers, as in cesarean section. Pedunculated tumors with twisted pedicle are readily removed by excising a wedge-shaped area of musculature at the base of the pedicle and closing the resulting gap with suture. Necrotic or degenerated fibroids are enucleated, and their bed sutured, even if the defect extends down to the decidua.

PARTICULARS OF TECHNIC.—When laparotomy is necessary, it will be found that the uterus is most tolerant during the third to fifth month. The incision should be ample, to facilitate the necessary manipulation. If myomectomy is to be performed, the growths—never any part of the uterine musculature—should be seized with volsella; evisceration of the uterus is to be avoided. Shelling out of the fibroids is particularly easy during gestation, but the resulting hemorrhage is profuse. Careful obliteration of the bed by deep buried (continuous No. 3 plain catgut) and superficial sutures (No. 2 plain catgut) is, therefore, essential. Should the bleeding prove alarming, the fetus and placenta may be removed by incising the uterine cavity and the uterus encouraged to

contract. After thus emptying the uterus, myomectomy may become feasible in cases which would otherwise require hysterectomy on account of uncontrollable bleeding.

AFTER-TREATMENT OF MYOMECTIONY.—If the pregnancy has been allowed to continue, the patient should be kept fully under the influence of morphin for at least 2 days, and then receive rectal suppositories of opium, gr. 1 (0.06 gm.), and belladonna, gr. $\frac{1}{4}$ (0.016 gm.), twice or thrice daily for 2 days more. Should abortion supervene, strong labor pains, which might rupture the recent scar, are forestalled by dilatation of the cervix and operative removal of fetus and placenta from below. If this or subsequent labors go to term, the delivery should be cautiously conducted, because of possible stretching or rupture of the uterine scar. In my experience labors occurring after myomectomy have proved uneventful.

Treatment near Term or during Labor.—Growths which do not obstruct the pelvis require no interference. Fibroids in the lower uterine segment or cervix are watched. The majority will flatten out and be drawn above the brim during the first stage of labor. A cautious attempt to push pedunculated tumors out of the pelvis may be made (anesthesia, entire hand in the vagina, Trendelenburg or elevated Sims posture). Not until serious dystocia develops and the head is prevented from entering the pelvis is operative interference called for.

VAGINAL OPERATION.—Vaginal operation may be tried for fibroids prolapsed low in Douglas' culdesac, or pressed down in front of the presenting part onto the vaginal vault. The operation should not be undertaken until dilatation is almost complete. An incision is made in the anterior or posterior fornix, the capsule is opened, and the growth enucleated. In the case of pedunculated tumors the pedicle is ligated; the bed of sessile growths is obliterated by suture. The vaginal incision may be drained with gauze or closed by suture. In every case the hemostasis must be exact. Delivery is then completed by version or forceps, as indications arise. The operator may be unpleasantly surprised by finding that the tumor extends upward beyond his reach, so that complete hemostasis becomes impossible and conclusion of the operation by the abdominal route becomes necessary.

ABDOMINAL OPERATION.—Should vaginal removal fail or appear hopeless from the outset, laparotomy must be resorted to. Some authorities advise removal of the growths and then completion of the delivery through the natural passages. Unless the pelvis is large, the cervix fully dilated and the patient a multipara, this method should never be considered except in cases where infection has taken place and cesarean section is extra-hazardous. Under ordinary conditions the classical cesarean section is to be preferred, followed by myomectomy. Removal of the uterine tumors is greatly facilitated by this measure. Should the entire uterus be found to contain numerous fibroids, hemorrhage prove to be uncontrollable, or the positive indications for Porro's operation exist, hysterectomy must be performed. Supravaginal amputation, according to the usual technic, is then carried out. Only in those cases in which the fetus is

surely dead and the uterine contents infected, does amputation of the unopened uterus come into question.

Treatment Post Partum.—Intervention is necessitated by the complications caused by the myomata—manual removal of an adherent or incarcerated placenta, tamponade for hemorrhage, replacement of the uterus for inversion (sometimes preceded by enucleation of the submucous fibroid), or hysterectomy where the placenta cannot be reached or the hemorrhage is uncontrollable.

Treatment in the Puerperium.—If necrosis or infection of fibroids appear (fourth to tenth day), manifesting themselves by pain, local tenderness, peritonitic symptoms and fever, operation should be performed, unless the response to palliative measures (opium, ice-bag) is prompt. Myomectomy or hysterectomy, depending upon the number of growths, the presence or absence of purulent foci and the severity of the infection, are the required measures. Myomectomy is more hazardous than hysterectomy in the presence of infection. Submucous fibroids may cause bleeding, chills and fever and toxic symptoms. They may be partly or completely extruded through the cervix. If high up in the fundus, enucleation after splitting the cervix, as in vaginal cesarean section, is performed. Extruded growths are removed by traction and torsion, after the uterine mucosa, overlying their pedicle, has been incised. Large sloughing masses may require vaginal hysterectomy. Thrombophlebitis and general sepsis are treated according to the usual principles (page 550).

2. CARCINOMA OF THE CERVIX

Carcinoma of the cervix is of comparatively rare occurrence during pregnancy, chiefly because it is a disease of later life. Pregnancy greatly stimulates the growth of cervical cancer. (Wertheim, whose experience is extensive, does not agree with this generally current view.) Therefore, if discovered in the early months and still operable, radical extirpation should be practiced with total disregard of fetal life. During the later months, in operable cases, the mother's chances should not be jeopardized by awaiting full viability. If already inoperable, palliative treatment until term is indicated.

During labor, carcinoma of the cervix proves a fruitful source of danger (hemorrhage, infection). Operable cases must be subjected to cesarean section followed by immediate radical hysterectomy. Inoperable cases may be treated by allowing labor to take its natural course, if no circular involvement exists and the cervix is not too rigid. The child's life is of chief importance; it should be safeguarded by cesarean section, should the necessity arise. The palliative treatment in pregnancy and the puerperium does not differ from that usually practiced.

3. OVARIAN GROWTHS

Ovarian tumors, especially cysts, are a fruitful source of trouble during and after pregnancy, although their growth is not usually stimulated during gestation.

Symptoms arise during pregnancy and in the puerperium from torsion of the pedicle, impaction in the pelvis, and infection from the gastro-intestinal tract. During labor, cysts in the pelvis often cause serious or fatal dystocia. They may be torn loose (intraperitoneal hemorrhage) or be ruptured (peritonitis, dissemination of malignancy).

Ovarian tumors discovered in the earlier months of pregnancy, especially if in the pelvis or intraligamentous, should be removed. Abortion is least likely to take place in the third to fifth month. After the fifth month, unless serious symptoms develop, viability of the child may be awaited. The danger of abortion following operation is approximately 20 per cent. It is increased if the affected ovary—should this contain the corpus luteum (corpus luteum cysts the size of a hen's egg are common)—is removed before the eighth week of gestation. Malignant tumors, if operable, require immediate removal when discovered. During the puerperium, ovarian growths should be operated upon only if they produce disturbance. (For the literature see Barrett, 1.)

1. Treatment during Pregnancy.—The abdominal route is to be chosen. An incision through the fibers of the rectus muscle assures a strong scar. The growth should be developed, the uterus itself not being touched. Secure ligation of the pedicle (mass ligatures and individual ligation of the vessels) is of importance. The stumps are peritonealized.

2. Treatment during Labor.—During labor only obstructing tumors require treatment. One careful attempt at reposition, under narcosis, is permissible. Should this fail, operative removal of the growths is indicated. It is not proper to attempt to deliver the fetus alongside the tumor (danger of rupture).

VAGINAL REMOVAL.—The usual advice given allows of choice between vaginal and abdominal removal. I am unqualifiedly opposed to the vaginal route except by expert vaginal operators in easy cases—small, non-adherent cysts pressed far down into the posterior culdesac by the presenting part. Even in supposedly easy cases, undiagnosed adhesions, inaccessibility or tearing off of the pedicle and uncontrollable hemorrhage may oblige the operator to complete the removal from above.

TECHNIC OF VAGINAL OÖPHORECTOMY.—The growth is exposed by a transverse or longitudinal incision in the posterior fornix. If cystic (no attempt to remove solid growths larger than a fist should be made per vaginam—morcellement contra-indicated!) the lower pole of the tumor may be seized, drawn into the vaginal wound, and punctured with a trocar, under continuous irrigation. As the cyst is emptied, it is delivered into the vagina, its pedicle is *securely* ligated and allowed to retract. Bleeding from the vaginal edges is controlled by suture. The delivery of the child is then accomplished. Immediately post partum a gauze drain is inserted into the posterior culdesac and removed after 48 hours.

If the pedicle is inaccessible before the delivery of the child, the emptied cyst may be anchored to the vaginal edge by a few sutures. Post partum the

pedicle becomes more accessible and can be ligated. Tearing off of the pedicle requires immediate laparotomy.

REMOVAL FROM ABOVE.—Several modes of procedure come into question. Should the unopened tumor be removed and the labor terminated from below? May the tumor, if cystic, be punctured before it is removed? Should cesarean section, followed by oöphorectomy, be practiced? The question of the stage in labor at which it is best to operate also arises.

In my opinion the following course should be adopted. If dystocia develops, one tentative and cautious attempt at reposition in narcosis may be tried. After this has failed, immediate laparotomy is indicated; the earlier in labor this is done, the better. The abdomen is opened and the cyst palpated.

(1) If the cyst can be delivered out of the pelvis, and this is exceptional (possible only if it is small, not adherent and pedunculated), oöphorectomy may be performed in young multiparæ and delivery completed from below, provided the birth passages are roomy, the presentation normal, and cervical dilatation far advanced. This procedure leaves a uterus unweakened in subsequent pregnancies.

(2) If the cyst cannot be delivered out of the pelvis, if it is unmistakably of the simple unilocular variety, and the patient falls into the class just described, the cyst might be emptied with a trocar and the procedure described above carried out. This technic is not advised and is absolutely contra-indicated in multilocular, dermoid or malignant cysts.

(3) In neglected cases in which the uterine contents are presumably infected by repeated and prolonged attempts at delivery of the fetus, removal of the cyst with or without puncture (unless contra-indicated—see 2) and delivery of the child per vaginam offer advantages. It may, however, be impossible to free the cyst without emptying the uterus.

(4) In the majority of cases (primiparæ, undeliverable tumors whether cystic or solid, contracted pelvis, etc.), cesarean section followed by oöphorectomy is indicated. Whether classical or Porro-cesarean section should be selected will depend upon the usual criteria.

SPECIAL TECHNIC.—The incision should be entirely below the umbilicus. If methods (1), (2), or (3) are chosen, the pedicle must be ligated with great particularity in order to prevent slipping of the ligatures during the termination of labor, and the abdominal wound must be reinforced by through-and-through sutures of heavy silk. If method (4) is carried out, cesarean section is performed as usual. Oöphorectomy then follows according to the accepted technic (Vol. V, p. 319).

Should a cyst rupture during attempts at reposition, or during delivery, laparotomy within 12 hours of delivery must be performed.

In grave emergencies, when assistance is not to be had, tapping of the cyst through the posterior fornix has been resorted to. Oöphorectomy, immediately post partum, is then indicated.

4. TUMORS OF THE VULVA, VAGINA, AND PELVIC BONES

Tumors of the Vulva.—The rare obstructing tumors of the vulva (Bartholinian cysts, fibromata, etc.) may be removed intra partum. Very often they are pushed aside and cause no trouble. This is of advantage in case of abscesses, which are more safely drained after the puerperium.

Vaginal Cysts.—Vaginal cysts may be tapped and emptied during labor and removed immediately after delivery is effected. Unless of large size, they accommodate themselves to the passage of the fetus. Tumors of the pelvic connective tissues (congenital cysts, fibromata, dermoids, echinococcus cysts), if of such size as to cause dystocia, are most safely treated by performing cesarean section at term, and postponing the removal of the growth until after full involution has taken place. The enormous vascularity of the parts renders operation during pregnancy or labor difficult or impossible.

Tumors of the Pelvic Bones.—Tumors of the pelvic bones (enchondromata, osteosarcomata, etc.), even if small, prove dangerous, because the soft parts are pressed against the solid growth during labor, and necrosis ensues. Therefore, cesarean section at term and radical removal at a subsequent date are usually the safest treatment.

Other Conditions.—Dystocia arising from unique or rare conditions, such as pelvic kidney, vesical calculus, rectal cancer, parametric infiltrations, etc., must be treated according to the principles indicated above.

TREATMENT OF POST-PARTUM HEMORRHAGE

A loss of blood up to 1 pint (500 c. c.) rarely produces noticeable symptoms. The loss of greater quantities is borne differently by different individuals. Irrespective of the amount lost, when the pulse becomes rapid (over 120), smaller in volume, and dizziness, faintness, air-hunger and pallor develop, the patient's condition should be considered grave; therefore, prompt measures should be taken to stop the bleeding before this state has been reached.

Prophylaxis.—Post-partum hemorrhage is best avoided by properly conducting the second and third stages of labor. Too sudden emptying of the uterus (twins, hydramnios, rapid breech extraction, etc.), prolonged administration of an anesthetic, and protracted labor, with overdistention of the lower uterine segment, favor the occurrence of bleeding. A full bladder, either in the second or third stage of labor, increases the tendency to hemorrhage. In the third stage too early attempts at Credé's expression, traction on the cord, and too vigorous massage are more harmful than allowing the uterus to balloon through lack of supervision. The proper course consists in firmly resting the cupped hand upon the fundus and anteverting the uterus by moderate pressure until the placenta separates. This separation is recognized by the fact that the hard fundus becomes movable, and is felt at a higher level. Often it appears to

be superimposed on a boggy mass immediately above the pubes. The cord also descends out of the vulva as the placenta approaches the vagina. It is a safe rule not to leave the patient until 1 hour after the birth of the placenta. No patient whose pulse is above 100, and from whom there is a steady trickling of blood, should be left by the physician.

Hemorrhage appearing while the placenta is still in the uterus requires removal (attempt Credé) of the placenta, first in order to favor retraction of this organ, second in order to distinguish bleeding from the placental site from bleeding



FIG. 45.—CREDÉ'S METHOD OF EXPRESSING PLACENTA. During a contraction the operator firmly grasps the fundus through the relaxed abdominal wall and forces the uterus into the pelvis. Simultaneously he approximates his thumb and the other fingers in order to squeeze out the afterbirth.

due to lacerations (page 523). It must, however, be remembered that a moderate amount of bleeding is physiological at this stage.

CREDÉ'S EXPRESSION.—Uterine contraction is brought about by gentle rubbing of the fundus. During the height of a contraction 4 fingers grasp the posterior surface of the fundus through the abdominal wall, the thumb lying on its anterior aspect. Firm pressure downward and backward in the axis of the birth canal is made, until the uterus is felt to empty and the vulva begins to bulge. Slight additional pressure behind the symphysis will complete the birth. If unsuccessful, first one, then the other horn of the uterus is grasped during the maneuver. Finally Credé's maneuver may succeed if a light degree of anesthesia is induced (Fig. 45).

Should 2 or 3 attempts prove unsuccessful, and the hemorrhage continue to

an alarming degree, it will prove necessary to have recourse to the serious interference of manual extraction of the placenta.

MANUAL EXTRACTION OF THE PLACENTA.—While an assistant temporarily controls the fundus, the accoucheur slips on a fresh pair of gloves and washes off the vulva. Preferably the patient should be laid transversely across the bed or on a table; usually time is lacking to accomplish this change. A sterile towel is placed on the abdomen. Through this the operator grasps the

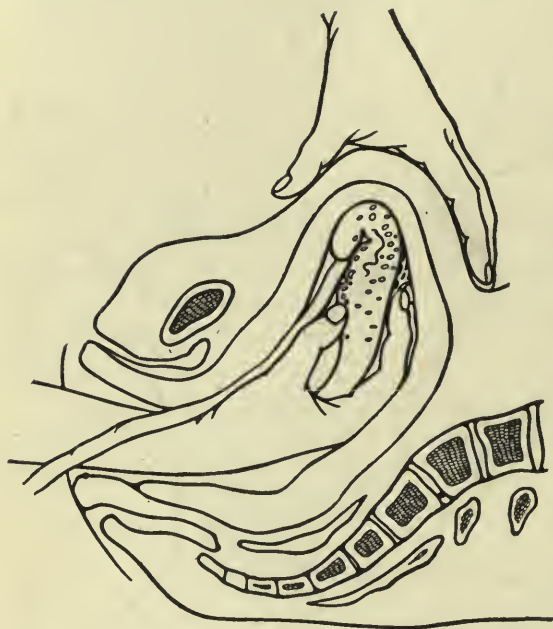


FIG. 46.—MANUAL EXTRACTION OF PLACENTA. The operator's left hand pushes down the uterus by pressure through the abdominal wall. Meanwhile the right hand has invaded the uterus, using the cord as a guide, and is engaged in peeling off the placenta, great care being exercised to keep within the proper layer.

fundus. The other hand is inserted entirely into the vulva, and the fingers reach the uterine cavity along the posterior vaginal wall (the cord is a reliable guide), if possible outside the membranes (Fig. 46). By firm downward pressure from above, the entire uterine cavity is brought within reach. The placenta is carefully peeled loose, care being taken to keep in the proper plane of cleavage close to the uterine wall. When the entire placenta is felt to be freed, the cupped hand is withdrawn together with the afterbirth.

At times, **hour-glass contraction** at the junction between the upper and lower uterine segment will render access to the fundus difficult.

A light anesthesia and careful dilatation with the finger tips (along the course taken by the cord) will overcome this obstacle.

After removal of the placenta it should be minutely examined for evidence of detached and retained cotyledons. If parts have been retained, the uterus must be reëntered and such fragments removed with the finger. Retained membranes need not be removed.

The uterus is at once irrigated with hot, sterile water (120° F., 50° C.) by means of the intra-uterine douche point. If the hemorrhage ceases, nothing further need be done, except the exhibition of 30 minims (2 c. c.) of aseptic ergot and careful massage.

Hemorrhage beginning or continuing after the expulsion or removal of the placenta may come from the placental site, or from lacerations of the uterus,

cervix, vagina and vulva. For the treatment of these latter we refer the reader to Treatment of Birth Injuries (page 518). Bleeding from the placental site can usually be excluded (except in placenta prævia) if the fundus remains firm and small.

MODERATE HEMORRHAGE.—In moderate degrees of hemorrhage, uterine massage and downward pressure on the fundus, hypodermic injection of ergot, and close approximation of the patient's thighs may be tried for a short period (5 to 15 minutes). Catheterization should be performed. If these measures fail, it is best (it being well understood that the entire placenta must have been expelled or removed) to tampon the uterus.

SEVERE HEMORRHAGE.—In foudroyant bleeding, the desperate condition demands emergency measures. Even the loss of a minute of time may prove fatal. The external hand firmly grasps and pushes the fundus into the pelvis and anteфлекs the uterus over the symphysis. The other hand is inserted into the vagina in fist form, elevating the vaginal vault and cervix, compression between the 2 hands being maintained until ergot has been given, the hot douche made ready, or assistance summoned. Another method consists in pushing the entire fist up into the fundus and making counterpressure from above.

Other means, which do not necessitate entrance into the birth canal, consist of external compression of the aorta or application of the Momburg belt for 20 to 30 minutes (Vol. II, p. 281). Whichever means are employed, hemostasis is maintained until the bleeding diminishes to such a degree that the uterus can be packed.

TAMPONADE OF THE UTERUS.—The uterus may be packed without an assistant. The operator sits in front of the patient, who is placed across the bed with knees flexed and abducted. By means of pressure from above on the fundus, the anterior lip of the cervix is made to appear at the vulva and is seized with an ovarian clamp. The traction in itself helps to reduce the bleeding. Then the end of a long strip of iodoform gauze, 6 to 12 in. (15 to 30 cm.) in width, is grasped with a blunt pointed intra-uterine dressing forceps (or ovarian clamp) and carried upward and forward to the fundus of the uterus. If assistance is available, the assistant (nurse or midwife) places his hand firmly on the abdomen over the fundal region, and informs the operator when the instrument reaches the fundus (impulse transmitted). The forceps is withdrawn (almost out of the cervix), a new hold of the gauze is taken, and this is again carried upward (Fig. 47). This maneuver is repeated until the entire uterine cavity is firmly packed. If the 5-yd. strip is insufficient another strip is knotted to it. Finally the vagina is tightly packed.

By sitting close to the bed, and by covering his knees with a sterile towel, which is spread directly to the vulva, the operator can maintain perfect asepsis.

Tamponade may also be performed without instruments. The end of the strip of iodoform gauze is seized by the finger tips and carried directly up to the fundus, the external hand making the uterus accessible by downward pressure. Without removing the internal hand completely, more and more of the gauze is

snugly stuffed into the cavity until the fundus and cervix are plugged. The vagina is then tamponed with plain gauze.

Whichever method is employed, if properly executed, tamponing will control nearly every hemorrhage. The only other non-operative means remaining are aortic compression exerted manually, or the constricting belt through the abdominal wall.

OTHER METHODS.—In case of uncontrollable and persistent hemorrhage,



FIG. 47.—TAMPONADE OF UTERUS. The patient lies transversely across the bed. The operator sits close to the bedside and has spread a sterile towel, reaching to the vulva, over his knees. The anterior lip of the cervix is grasped and pulled down by an ovarian clamp. Gauze can now be passed into the uterus without danger of contamination. When available, an assistant should grasp the fundus from above (dotted lines).

the abdomen may be opened, and both uterine and ovarian arteries ligated (hospital). Collateral circulation will later be established.

Henkel advises application of volsellum forceps laterally in the vaginal vault in the course of the uterine vessels. Upon them traction is exerted. This method should prove both difficult and dangerous.

Kehrer (12) describes a technic applicable to desperate cases. Small median suprapubic incision and eventration of the uterus, the neck of which is grasped by an assistant, are the first steps. A double-armed, heavy silk suture is passed through the cervix in an anteroposterior direction, and each half is then passed through peritoneum and fascia on respective sides of the wound edges in front

and behind the cervix. When these ligatures are tied, all vessels have been compressed. The uterus is amputated at the level of the wound, and the parietal peritoneum above and below the stump is united to the cervix, followed by complete closure of the wound.

After-treatment.—After-treatment consists in combating the loss of blood and shock by elevating the foot of the bed, applying heat, bandaging the legs (autotransfusion), hypodermoclysis, intravenous infusion, hypodermatic stimulation (camphor, strychnin, caffein). Later rectal infusions may be given, and, when the anemia is extreme, transfusion of blood may be considered.

Late Post-partum Hemorrhage.—Occasionally serious bleeding occurs as late as 1 or more weeks after labor. It may be due to subinvolution, fibroids, or retained portions of placenta. The treatment will depend upon the cause—packing for temporary hemostasis; manual removal of the placenta, if it does not come away with the gauze.

TREATMENT OF THE PLACENTA PRÆVIA

When the placenta extends down to the fully dilated internal os, the condition is called **marginal** (lateral) placenta prævia; when the os is partly covered, **partial**; and when fully covered, **complete** (central) placenta prævia. Before dilatation has advanced, it may be impossible to determine the variety to be dealt with. Nearly $\frac{2}{3}$ of all cases of placenta prævia produce symptoms before term has been reached. The rhythmic uterine contractions during pregnancy, or at the beginning of labor, cause some dilatation of the lower uterine segment and thereby detach the portion of placenta situated in this zone. Consequently the pathognomonic symptom—hemorrhage without apparent cause, and unaccompanied by pain—is produced. If this occurs (usually in the last 3 months of gestation), the diagnosis should be confirmed by feeling for placental tissue through the cervix. If this cannot be done, the case should, nevertheless, be treated as one of placenta prævia. Only in exceptional circumstances (hospital surroundings and slight bleeding) may term be awaited. The safer treatment is immediate induction of labor. Moreover, the obstetrician must be prepared to devote his entire time to the patient until delivery has been completed. He will require a full instrumentarium, including means for combating hemorrhage, the presence of a nurse and at least 1 assistant. Unless these requisites can be obtained, the patient should be transferred to a hospital. Disregard of 1 or more attacks of bleeding, unpreparedness, and haste in delivery have raised the mortality of placenta prævia to frightful proportions in private practice (20 to 30 per cent.) instead of reducing it to the figures of well-conducted maternities (3 to 9 per cent.).

Treatment before Labor Has Set In.—(1) If the cervix is not sufficiently dilated to admit 1 finger, a firm cervical and vaginal packing of iodoform gauze should be inserted, to produce hemostasis and to dilate the cervix. The patient

is then transferred to a hospital unless the home surroundings are exceptionally good. (2) As soon as the cervix admits 2 fingers, especially if the hemorrhage proves profuse, the surroundings are unfavorable (or assistance lacking) and the child premature, a Braxton Hicks version (page 469) is performed (after rupture of the membranes or perforation of the placenta). When the foot has been drawn to the vulva, further dilatation is left to the labor pains, unless bleeding continues, in which case a continuous traction of 1 to 2 pounds may be exerted on the leg. Sometimes the foot can be felt but not grasped. It may then be seized and drawn down by an ovarian clamp passed through the cervix alongside of the fingers. (3) In favorable surroundings, if the child is alive and viable, a metreurynter may be inserted within the ovular cavity (by rupturing the membranes in lateral, or perforating the placenta in central placenta prævia). Slight traction is kept up to control the bleeding. The largest bag possible should be used, so that its expulsion coincides with full dilatation. At times (cervix high and fixed) the bag cannot be applied within the membranes. Then supervision must be specially rigid, as concealed bleeding above the bag may occur. Expulsion of the bag through the cervix must be watched for (digital examinations), for, as soon as the metreurynter is extruded into the vagina, further steps are at once to be taken, otherwise large quantities of blood may accumulate behind the bag.

Treatment during Labor.—In some cases no bleeding is noted until labor has set in. If the cervix is soft and partly dilated, the pains strong, the bleeding moderate, and the placenta marginal, rupture of the membranes may prove sufficient. The further progress of labor should then be carefully supervised, and the second stage hastened in the interest of the child. If rupture of the membranes proves insufficient to control the bleeding, the accoucheur may still resort to intra-ovular metreurynter, to be followed, if necessary, by version (but not extraction).

No attempt to deliver should be made until the cervix is fully dilated.—The hemorrhage is controlled by the presenting part, whether this be head or breech. Rapid extraction invariably produces lacerations of the cervix, which in the third stage cause uncontrollable and fatal hemorrhage.

COMPLETION OF DELIVERY.—In cephalic presentation, as soon as the cervix has fully dilated and the head has entered the pelvic cavity, forceps may be applied, if the pains are weak. In breech presentation (primary or after version) the child is extracted as soon as the cervix is fully dilated.

As soon as the child is born, the cord is clamped and cut, and the infant handed to an assistant. The accoucheur must devote his entire attention to the conduct of the third stage of labor. The fundus is grasped. If there is bleeding, the placenta should at once be removed manually and the uterine cavity irrigated. If bleeding continues, the uterus and vagina are firmly tamponed without delay. The shock and anemia are then treated as indicated under Post-partum Hemorrhage.

Choice of Methods.—Preliminary tamponade is useful in emergency, until

help can be summoned or the patient transferred to a hospital. Braxton-Hicks version can be performed without assistance as soon as the cervix admits 2 fingers, but it usually involves loss of the child. It is the method of choice when the child is not viable. Metreuryisis saves nearly 60 per cent. of all viable children without additional danger to the mother; it requires experience and good technic. Rupture of the membranes is applicable only in the marginal type. Accouchement forcé has been generally abandoned; it saved the children, but lost the mothers. High abdominal cesarean section has occasionally been performed, where hemorrhage was profuse, the cervix undilated and rigid (old primiparæ), the child viable, and the mother uninfected.

Doederlein (4), in 5,615 cases delivered in German maternities, found the maternal mortality 8 per cent., the fetal death rate 54 per cent.

METHOD	NO. OF CASES	MATERNAL MORTALITY	FETAL MORTALITY
Rupture of membranes.....	309	0.9 per cent.	25 per cent.
Braxton Hicks.....	1434	7.8 per cent.	73 per cent.
Metreuryisis.....	—	6.5 per cent.	45 per cent.
Cesarean section.....	146	8.9 per cent.	30 per cent.
Vaginal cesarean section.....	159	11.3 per cent.	21.7 per cent.

Precautions Necessary.—Immediate inception of treatment after the condition is recognized is important. It is the anemia produced by repeated small hemorrhages which raises the mortality; the additional loss of blood during labor kills these patients. Painstaking preparedness and rigid asepsis are essential, for the anemia increases the susceptibility to infection, and the proximity of the placental site to the vagina multiplies the danger of sepsis. Dilatation must be entrusted to the natural forces; otherwise, lacerations of the overvascularized and fragile lower uterine segment result. Throughout all stages of the delivery, every drop of blood that is saved improves the ultimate chances of recovery.

Miller (14) advised exposure and ligation of the uterine arteries from below, in cases of severe bleeding. The vessels are reached by a small incision in the fornix one finger's breadth to the side of the cervix. The further treatment is by metreuryisis, version, etc., depending on the general indications.

PREMATURE DETACHMENT OF THE PLACENTA

Hemorrhage from a normally situated placenta is a rarer and also graver complication than placenta prævia. The differentiation may be difficult before some dilatation of the cervix has taken place.

Two causes have been assigned: (1) Mechanical (trauma; rapid diminution in size of the uterus during labor, when hydramnios or twin pregnancy exists; direct traction by a short cord); (2) tissue changes (especially in chronic nephritis and intense albuminuria; more rarely inflammatory decidua or mus-

cular alterations). The blood may collect behind the placenta (**occult, internal**), or may dissect its way along the membranes and appear at the vulva (**external**), or both varieties may be combined (**mixed**).

Symptoms during Pregnancy.—During pregnancy, in the earlier months, accidental hemorrhage is one of the common causes of abortion. In the later months grave symptoms may rapidly develop. In severe cases, without apparent warning (except perhaps nephritic symptoms), severe abdominal pain is felt, accompanied by all the systemic signs of internal or external hemorrhage. The uterus is large, boardy in consistence, tender to pressure; the fetal parts are not to be distinguished. The size of the uterus may increase during observation (accumulation of blood). A distinct asymmetry (corresponding to the retroplacental hematoma) has been felt by me in 2 cases. If the os is patulous, marked tension can be felt in the occult variety; in the external or mixed type blood oozing or gushing from the cervix can be noted.

Treatment before Labor Has Set In.—If the general symptoms are mild, and the patient's condition is good, labor may be induced by introducing a bag. It is far safer to transport a patient to a hospital and prepare everything for vaginal cesarean section (multipara) or abdominal cesarean section (primipara). In mild cases labor is induced and delivery hastened by the use of forceps or version, as soon as the cervix has completely dilated. Version must be executed with great care, as interstitial hemorrhages of the uterus have been noted repeatedly at autopsy. The affected area of the uterine wall is then found much weakened. If the child is dead, perforation will simplify and hasten delivery. Should the general condition grow worse, rapid emptying of the uterus by vaginal cesarean section (page 458) followed by version, or by classical or Porro-cesarean section (page 507), must be resorted to. Accouchement forcé adds shock to the collapse due to the hemorrhage. This applies as well to the forcible dilatation with the Bossi dilator.

Treatment during Labor.—As the cause of the hemorrhage is usually rapid but incomplete retraction of the uterus, this organ should at once be completely emptied. The method of choice will depend upon the strength of the patient, the amount of bleeding, the stage of labor, and the condition of the cervix. In hydramnios and twin pregnancies delivery is usually easy. With an only partly dilated cervix the choice will lie between metreurysis, manual dilatation (soft multiparous cervix), vaginal cesarean section, and abdominal cesarean section (primipara, small pelvis, malpresentations). Vaginal delivery is terminated by forceps, if the head is engaged, or by version, unless this is contra-indicated. Version, in this condition, must always be performed with exceptional care because the uterine musculature may have been weakened by interstitial hemorrhages, previously referred to. The placenta commonly prolapses into the vulva as soon as the child is extracted. If the after-birth is not spontaneously expelled, it is removed manually. Post-partum hemorrhage is usually severe and persistent. The atony and anemia are treated according to the rules previously laid down.

The accoucheur, as soon as premature detachment is diagnosed, must realize that he is confronted with one of the most fatal complications of pregnancy (maternal mortality 30 to 50 per cent., fetal mortality as high as 95 per cent.). The mother is not safe until the uterus is empty, and no method of temporary hemostasis, such as is available in placenta prævia, has been found. In severe degrees of the condition, therefore, radical measures, such as cesarean section, are fully justified.

ADHERENT PLACENTA

Most cases of "adherent placenta" are placentaë not yet separated from the uterine wall. Expectancy (1 or more hours), if there is no bleeding, will eventually be crowned by success.

Rarely, because of pathological changes, true adherence occurs. After all measures have failed, manual removal, piecemeal, will be necessary. A number of cases, in which hysterectomy was finally resorted to, are on record.

ECLAMPSIA

Most obstetricians, at the present time, group various symptom-complexes, which are characterized by toxemia, whether accompanied by convulsions or not, under the generic name of "eclampsia." At the post-mortem table lesions pathognomonic of eclampsia are noted in the liver, kidneys, and other organs, so that these rare instances of fatal "eclampsia without convulsions" can also be recognized.

The poison of eclampsia has never been isolated. Its nature is unknown, but it is either inherent in or elaborated by the products of conception (fetus or placenta). Although emptying of the uterus, if performed in time, cures the disease, other therapeutic measures, chiefly non-operative in nature, are employed prophylactically or as adjuvants to the removal of the fetus and its placenta.

Varieties of Eclampsia.—The varieties of eclampsia might be classified into renal, hepatic, or septic types, depending upon the main localization of the poison in the various organs. In the renal type the most striking symptoms are referable to the kidneys—diminution in the quantity of urine, severe albuminuria, granular and epithelial casts, albuminuric retinitis; the hepatic type resembles acute yellow atrophy of the liver—typhoid state, jaundice; the septic is characterized mainly by deep coma, multiple visceral hemorrhages, and high temperatures. At some period of the disease, in all 3 varieties, severe general convulsions may supervene, and may recur again and again, until death is ushered in by deep coma and edema of the lungs. Eclampsia may occur during pregnancy (usually in the last 3 months), during labor, or in the puerperium—

approximately with a frequency of 20 per cent., 60 per cent., and 20 per cent. respectively, in the order given.

Prognosis.—The maternal mortality has been computed variously from 5 to 30 per cent. It is highest in those patients who develop the disease before labor, and lowest in post-partum eclampsia. The fetal mortality approximates 50 per cent. As the average maternal death rate approaches one in 5, the grave nature of the disease can be readily conceived.

Symptoms.—**PREMONITORY.**—In a vast majority of cases, eclampsia documents itself by well marked prodromata. Briefly summarized, they embrace renal (oliguria, albuminuria, indicanuria, albuminuric retinitis), vascular (edemas, high blood-pressure—170 to 200 mm. of mercury), gastro-intestinal (indigestion, nausea, vomiting, severe epigastric pain), and cerebral (headache, dizziness, “flashes” of light, amaurosis, somnolence, or excitation) symptoms. Frequently some elevation of temperature and a high leukocytosis is noted. When the prodromal stage is well defined early recognition and prompt treatment may avert the threatened attack. Too often eclampsia is not forestalled because routine urine examinations are neglected, or because the premonitory symptoms are not heeded by the physician.

THE ATTACK.—Repeated general convulsions, during which cyanosis, high pulse tension, and complete loss of consciousness are most striking, are noted. The number of seizures has varied from 1 to 200 or more, their duration lasting from $\frac{1}{2}$ to 2 minutes. In severe types of the disease consciousness is not recovered between the attacks. Usually labor pains begin, and sometimes prompt expulsion of the fetus occurs without intervention.

TREATMENT OF ECLAMPSIA

The treatment resolves itself into prophylactic, palliative (during the attacks), remedial (mainly consisting of emptying the uterus), and after-treatment (which includes the treatment of post-partum eclampsia).

Prophylactic Treatment.—Under prophylaxis are included the proper supervision and hygiene of pregnancy, especially routine urine and blood-pressure examinations. If one or more of the prodromal symptoms develop, the patient must be put to bed, the diet limited to milk and large quantities of water, the bowels moved daily with moderate doses of saline laxatives, and nervousness or insomnia overcome by repeated doses of bromids (20 gr., 1.3 gm., by rectum every 4 to 8 hours). The kidney function may be stimulated by copious hot rectal irrigations of normal salt solution (double current catheter), but this treatment should not be insisted upon if it excites or weakens the patient. Hot packs have been highly recommended. They, however, weaken patients greatly, and are no longer used by me. Unless prompt improvement develops, within 24 to 36 hours, marked by increase in the quantity of urine, decrease in albumin, disappearance of the gastro-intestinal and cerebral symptoms, and **fall of blood-pressure** (below 150 mm.), labor should be induced without delay.

If improvement is satisfactory, the diet list is gradually enlarged (cereals, bread, fruit, butter, 1 egg a day, and later vegetables, chicken or fish). Some clinicians advise a salt-free diet. The patient is allowed to get up after all symptoms have disappeared, but a careful watch is maintained throughout the remainder of pregnancy (urine examined thrice weekly). A recurrence of the symptoms justifies prompt emptying of the uterus without regard to the period of gestation.

EMPTYING THE UTERUS.—The method for emptying the uterus, where haste is not indicated, is induction of labor by means of the metrenurynter (page 453). Where an attack is more imminent, especially in multiparæ, rupture of the membranes should be resorted to, allowing considerable of the liquor amnii to escape (the resultant reduction of pressure appears to lessen the liability to convulsive attacks), followed by metrenyrisis, if pains do not develop promptly. The medical measures above described are, of course, likewise continued.

Palliative Treatment during the Attack.—The patient should be guarded during a convulsion—mouth gag (clothes pin) between the teeth, all constricting clothes cut loose, neighboring objects padded with pillows. Some obstetricians administer ether (in preference to chloroform) by the drop method, with the onset of the premonitory twitching which precedes each convulsive seizure, and continue the administration until the patient relaxes. Long-continued narcosis is, however, no longer resorted to. It is also inadvisable, in my opinion, to give large doses of morphin or chloral, until it becomes certain that consciousness is restored between attacks; otherwise, eclamptic coma may be deepened to a fatal degree. Between the fits the patient is not to be disturbed; external stimuli, such as light, noise, or examinations, are as carefully guarded against as in tetanus.

Remedial Measures in Pregnancy and Labor.—Three methods of treatment are most generally accepted. (1) Immediate emptying of the uterus (accouchement forcé, Bossi, Pomeroy bag, vaginal or abdominal cesarean section). (2) Purely medical measures (Stroganoff's method). (3) Medical treatment combined with the least violent method of inducing labor. I prefer the latter form of procedure, especially in all mild and moderately severe types of the disease (return of consciousness between the attacks, high tension pulse).

As the method of procedure will depend largely upon the severity of the disease, the treatment of each group has been outlined separately. The reader must bear in mind that such measures as were described under Prophylaxis must also be carried out, if the general symptoms (renal, gastro-intestinal, cerebral, etc.) indicate their use.

Combined Medical and Operative Treatment.—IN MILD CASES.—The usual method of procedure in a mild case would, therefore, be as follows: During the attack the patient is protected from injury. A dose of morphin (gr. $\frac{1}{4}$, 0.016 gm.) is given hypodermatically. As soon as the narcotic has taken effect, a vaginal examination is made. If labor has set in and the cervix is effaced and partly dilated, the membranes are ruptured. The patient is kept in a somnolent

state by means of alternate doses of morphin (gr. $\frac{1}{6}$, 0.01 gm.) by hypodermic, and sodium bromid (gr. 30, 1.9 gm.) by rectum, until spontaneous delivery has been effected.

If labor has not begun, a metreurynter is inserted under full narcosis (ether), and labor started. If there is delay, which is unusual, because the convulsions accelerate labor pains, the bag may be removed after a few hours, and the membranes ruptured.

IN SEVERER CASES.—In the severer type, the interval between the induction and termination of labor (which may be hastened by performing a Braxton-Hicks version) may profitably be employed by stimulating the kidneys and reducing arterial tension. Renal activity is encouraged by repeated subcutaneous infusions of normal salt solution (8 to 12 oz., 250 to 350 c. c.), every 3 hours, except in cases in which edema of the lungs is threatened. In these cases, or where the pulse is hard, full, and bounding, venesection is practiced. If no tendency to pulmonary edema is noted, the venesection is at once followed by an intravenous infusion of normal salt solution. In well nourished patients 8 to 10 oz. (250 to 300 c. c.) of blood are withdrawn, controlled by the blood-pressure readings (stop if the pressure sinks below 120 mm.), and an equal amount of saline solution substituted. Due allowance for a possible post-partum hemorrhage must also be made in anemic patients, and venesection restricted or not performed until after labor. The other measures previously detailed are, of course, resorted to.

IN THE SEVEREST FORM.—In the severest form, in which convulsion follows convulsion, consciousness is not regained between attacks, the pulse tension remains high, and anuria is nearly absolute, emptying of the uterus without delay is justified. Usually labor is well under way, so that internal version, followed by breech extraction (if necessary, with perforation of the after-coming head), is feasible. Should the cervix prove undilated, vaginal cesarean section, assisted by Dührssen's vaginal incisions in primiparæ, offers the promptest means of delivery. This method is to be preferred to abdominal cesarean section, typical accouchement forcé, or Bossi dilatation. If the pelvis is contracted, perforation of the after-coming head can be resorted to.

IN FATAL CASES WITH LOW PULSE TENSION.—Those rare and fatal cases in which the pulse tension is low, the prostration severe, and the coma deep, are poor subjects for rapid delivery. In them I prefer to resort to the medical measures described under Severer Cases, with the exception of morphin injections, which tend to increase the depth of the coma, and venesection, which is poorly borne. Labor is induced by rupturing the membranes, and any major intervention avoided if possible.

After-treatment and Treatment of Puerperal Eclampsia.—In most cases emptying of the uterus by no means completes the cure. In nearly 40 per cent. of patients 1 or more convulsions occur post partum. In post-partum eclampsia, the attacks first develop during the puerperium.

The advice given in regard to the treatment of prodromal symptoms covers

the measures employed for the after-treatment—stimulation of the kidney and bowel function, milk diet, reduction of blood-pressure, and quieting of the cerebral and general nervous excitability. Coma cannot be directly combated; elimination of the poison by way of the channels just enumerated is the sole remedial possibility.

Other Methods of Treatment.—IMMEDIATE FORCIBLE EMPTYING OF THE UTERUS.—Immediate forcible emptying of the uterus, such as was formerly generally practiced in all cases, is losing favor in the profession. Accouchement forcé is being replaced by vaginal cesarean section. Abdominal cesarean section, which has some strong supporters, can only come into question when the birth passages are entirely unprepared for delivery, or some marked obstruction to vaginal delivery is encountered; for eclamptic patients bear invasion of the peritoneal cavity as poorly as the average patient suffering from a severe acute nephritis. (Williams, 28, gives the mortality from abdominal cesarean section as 48.2 per cent., vaginal, 3 to 18 per cent.)

STROGANOFF'S TREATMENT.—This treatment (22) relies mainly upon the exhibition of narcotics according to a rigid program. This Russian author has reported a series of over 330 cases with a maternal mortality of only 6.9 per cent. The reports from German clinics, where this method has been tested, are not as favorable.

The patient is isolated, protected from outside influences, and given the usual medical treatment, previously mentioned. All interventions (catheterizations, examinations, rupture of membranes, or introduction of a bag) are conducted under light chloroform narcosis.

The narcotics are given as follows:

When first seen—Morphin gr. $\frac{1}{4}$ (0.016 gm.) hypodermatically.

1 hour later—Chloral gr. 30 (1.9 gm.) by rectum.

3 hours later—Morphin gr. $\frac{1}{4}$.

7 hours later—Chloral gr. 30.

13 hours later—Chloral gr. 15 to 20.

21 hours later—Chloral gr. 15 to 20.

On succeeding days—Chloral gr. 15 3 times a day.

R

Chloral hydrate.....	20.0	} For rectal use.
Mucilag. gum. arab.....	20.0	
Aquæ	200.0	
3vi = 30 gr.		

If the patient does not improve in the course of several days, labor is cautiously induced by the least disturbing method applicable, such as rupture of the membranes.

VERATRUM VIRIDE.—Veratrum viride has been widely used in the United States. Edgar and also Cragin still recommend it highly, to reduce the blood-

pressure, in conjunction with other forms of treatment. Five to 10 minims (0.3 to 0.5 c. c.) of the fluid extract (U. S. P.) are given every half to 3 hours until the pulse falls to 60 and the blood-pressure is low. Alarming collapses may occur, and great caution must be used in the exhibition of the drug, if its administration has been preceded by venesection.

MISCELLANEOUS.—Dienst has employed “hirudin” (leech extract) intravenously, as his experimental work has convinced him that eclampsia is due to accumulation of fibrin ferment.

E. Martin injected oxygen, Bolle potassium iodid solution into the breast, because veterinarians have regularly cured a disease analogous to eclampsia by these methods. Sellheim (20) goes a step further and amputates both breasts. Various other methods, such as lumbar puncture, renal decapsulation, intraspinal injection of magnesium sulphate, subcutaneous injection of human blood serum, etc., have met with neither general success nor recognition.

PUERPERAL INFECTION

The genital canal, immediately after labor, should be likened to a poorly drained open wound. Within 3 to 4 days this wound becomes infected, because by that time the bacterial flora has ascended from the vulva and vagina to the fundus of the uterus. Every puerpera might, therefore, be expected to fall a victim to wound infection, were it not for the fact that the human body has great powers of resistance.

Body Resistance.—In the puerperal woman, this resistance is mainly of 2 kinds: the one general, represented by the tissue fluids (bactericidal, antitoxic, etc.); the other local, represented by the protective leukocytic wall (granulation tissue) which rapidly covers over both the birth injuries of the lower genital tract and the denuded decidua areas in the uterus. The placental site remains open longest, and, therefore, is more vulnerable, the large openings of the uterine sinuses with their occluding thrombi offering an excellent portal of entry to late infection.

Under favorable conditions—that is, when the general body resistance is good, the physiological and accessory birth injuries not too extensive, and the bacterial contents of the vagina not too virulent—the reparative processes gain sufficient headway to establish an effective barrier, unless disturbed by outside interference. On the other hand, if the general resistance is impaired (previous illness, malnutrition, anemia), the birth injuries complicated (crushed or necrotic areas, pockets, lacerations communicating with the rectum), and the vaginal bacteria virulent, serious infection gains a foothold before repair has set in. The resulting illness is known as puerperal infection.

For many years, clinicians, pathologists, and bacteriologists have made earnest efforts to diagnose and classify the many varieties of puerperal infections encountered. The results are exemplified by a cumbersome and compli-

cated schema, which is rarely applicable at the bedside, as is made evident by the different interpretation of physical findings and prognosis in a concrete case, supported by men of equal experience and weight in the profession.

Because of this uncertainty, so incomprehensible to the general surgeon, who is accustomed to deal with clear-cut types of infection, a strong reaction against meddlesome and haphazard interference has made itself felt. I, therefore, feel justified in recommending extremely conservative measures in the treatment of puerperal fever, because, on the one hand, I frankly acknowledge my own inability in many instances to distinguish between the types of infection and the degrees of virulence of the process; and, on the other hand, I (like an increasing number of clinicians) have found the results obtained by non-interference superior to those formerly obtained by more radical measures.

Classification.—Just as in other regions of the body, the portal of entry to infection is represented by wounds in the surface covering—lacerations or abrasions of the vulva, perineum, vagina, cervix, or fundus (especially the placental site). These wounds rapidly become covered with a grayish exudate, forming the so-called puerperal ulcers in the lower passages; the various types of “septic endometritis” in the uterine cavity. The process may remain strictly localized or may extend. When it does extend, dissemination may occur along the **blood channels** producing general bacteriemia (bacteria circulating and multiplying in the blood), thrombophlebitis (a continuous infective thrombosis in the venous channels of the pelvis, lower extremities, and abdomen), or metastatic thrombophlebitis (in which the local thrombotic process is overshadowed by the multiple foci, resulting from infective emboli carried to distant parts by the blood-current—pyemia).

Extension may, however, also proceed through the **lymphatics** with resulting parametritis (pelvic cellulitis), perimetritis (infection involving mainly the subperitoneal tissues of the uterus, but always extending to the adjacent pelvic peritoneum), and peritonitis, either general or localized.

Each and every one of the above-mentioned types may occur alone or variously combined. To each one has been assigned some distinctive general or local symptom. Various bacteria, alone or in symbiosis—in particular the streptococcus, staphylococcus, colon bacillus, and gonococcus—of variable virulence, may be the invading germ. Can any one, with our present methods of diagnosis, hope to distinguish the localization, the type, the area of extension, the virulence, etc., with sufficient accuracy to permit him to employ an effective and yet never meddlesome or harmful local therapy in these cases? I think not, and, therefore, strongly advocate the routine use of other measures.

It cannot be denied that in some instances local therapy has given striking results—such as immediate defervescence after the manual removal of a retained cotyledon from the uterus, or recovery in an apparently hopeless case of “pyemia,” following the ligation of the pelvic veins. More frequent, however, though unrecorded in the literature, are the many cases in which curettage or even a “simple” intra-uterine douching has sufficed to carry infection from the

lower passages into the uterus, has extended uterine inflammation to neighboring structures, or, by rupturing newly formed delicate adhesions, has converted an encapsulated pelvic abscess into a general peritonitis.

Manifestations.—Puerperal infection may manifest itself by (1) general systemic disturbances—fever, chills, rapid pulse-rate, prostration, etc.; (2) local signs (a) in the genital organs—subinvolution, puerperal ulcers, sanious or purulent discharge; (b) in the pelvic connective tissues—local tenderness, evidence of exudates, abscesses, and thrombosed pelvic veins; (c) in the uterine adnexa—symptoms occasioned by pus tubes, ovarian or tubo-ovarian abscess; (d) in the pelvic or general peritoneum—abdominal tenderness, distention, vomiting, diarrhea, collapse; (3) metastatic foci—endocardial murmurs, symptoms due to abscesses in distant organs, thromboses of the lower extremities, etc. (4) Any of the foregoing types may be combined in various ways, producing more complex types. (5) In all of the foregoing types bacteria may be present or absent in the blood.

TREATMENT OF PUERPERAL INFECTION

Prophylactic Treatment.—This should begin from the very inception of pregnancy, and is planned on general hygienic lines, in an effort to get the patient into “training” for the ordeal of labor—sufficient rest, food, and exercise; proper care of the excretory organs (intestines, kidneys, skin); cleanliness; treatment of infections and local troubles (especially pus foci, etc.). In the last 2 months, local causes of infection, such as coitus, non-aseptic local examinations (by the physician or “self-examination” by the patient), entrance of bath water into the vulva, must be guarded against. From the onset and during the course of labor, the rules of asepsis, so frequently emphasized in these pages, must be strictly adhered to. This includes not only the careful sterilization of instruments and supplies, the scrupulous preparation of the hands of the obstetrician, and the adherence to the minutiae of surgical technic, but also the rigid limitation of internal examinations, the avoidance of “helpful” manual dilatations of the cervix, and the unnecessary application of forceps. It presupposes, moreover, the proper conduct of the third stage of labor, the removal of retained parts of the placenta, the recognition of birth injuries, and their immediate repair or treatment. Precautions must be continued throughout the puerperium. During this period their execution falls mainly into the hands of the obstetric nurse, who, by her coöperation, ensures the final success of childbearing and avoids the possible dangers of late infection by guarding the injured perineum, keeping the vulva clean, etc.

Examination.—If in spite of these elaborate precautions, or because of their neglect, infection develops, what is our mode of procedure? When rise of temperature, prostration, and local signs (pain, abdominal tenderness) show that something is wrong, the physician’s duty is to make a thorough physical examination of the patient—but to leave the genital canal untouched. This

examination should eliminate the possibility of any intercurrent illness such as influenza, pneumonia, etc., and of pyelitis or breast infection. Only if the perineum, vagina, or cervix has been repaired, should the sutures be inspected (thorough asepsis!). In the presence of grave symptoms, the sutures must be removed and the wounds laid widely open, irrespective of whether they appear suspicious or clean. No local treatment is indicated (beyond keeping the vulva protected), except that a fresh strip of iodoform gauze is to be laid into the gaping perineal tear whenever the vulvar pad is changed.

Should the general symptoms continue, and local and other signs (blood culture) point to a true puerperal infection, the following method of treatment is advised:

General Treatment.—Absolute mental and bodily rest is enjoined and maintained by isolation and restriction to the bed. Restlessness is treated by bromids, pain by morphin, insomnia by veronal or medinal. The diet should be a liberal fluid one (milk, egg-nogs, gruels, much water) to which semisolids may be added when the stomach tolerates them (cereals, eggs, meat juice). In protracted illness, scraped beef or chicken may be given regardless of the temperature.

The sickroom should be light and well ventilated. Open air (roof treatment) appears to stimulate the appetite and encourage sleep. High temperatures (above 103° F., 39.5° C.) are relieved by hydrotherapy (tepid or cold sponges, alcohol rubs, ice-cap); only if these measures fail, in extreme hyperpyrexia (104° to 105° F., 40° to 40.5° C.) which renders the patient somnolent, restless, or wildly delirious, may occasional doses of phenacetin or pyramidon be exhibited, under strict supervision, and with due regard to their depressing influence. The collapse following a chill is counteracted by heat, stimulation, and morphin.

The bowels should be moved daily by a low enema (soapsuds, or soapsuds and peppermint water āā). If peritonitic symptoms develop, it is safer to leave the bowels undisturbed for 2 or 3 days, until the process shows signs of localizing. Persistent diarrhea may be controlled by small doses of tincture of opium aided by tannigen. Increasing meteorism is combated by inserting an enema tip through the sphincter ani and applying turpentine stupes. Obstinate vomiting (an ominous sign) is treated by temporarily stopping all nourishment by mouth, and substituting nutrient enemata, subcutaneous infusions of normal salt solutions, or the Murphy drip (which tends, however, to increase the distention). Intravenous infusions rarely prove of use. Occasional stomach lavage (allow the patient the pleasure and relief of drinking a large glass of ice-water beforehand) will prove of value.

Abdominal tenderness is treated by an ice-bag or ice-coil applied above the pubis. Should involution prove slow (abdominal palpation!) or the lochia scant (lochiometra) uterine retraction and contraction are encouraged by small repeated doses of ergot (fluid extract, minims 30, 2 c. c., 3 times daily). As long

as the fundus remains above the promontory, drainage is favored by placing the patient in the Fowler position.

Drug treatment, as such, is of lesser value. The general stimulants in the order of their importance are caffein, camphor, strychnin, and digitalis preparations. They may be prescribed, according to general principles, if the illness is protracted and the heart needs stimulation. I employ alcohol in the form of stimulating enemata—whiskey oz. ss (15.5 c. c.), salt solution oz. iv (125.0 c. c.)—3 times a day, only if the amount of daily nourishment is insufficient. Urotropin is of service when the urinary tract is infected, or as a prophylactic in gonorrheal cases.

Further Course.—The symptoms of infection usually appear within 48 to 72 hours after labor in severe virulent types; between the sixth and ninth day in the majority of cases; toward the end of the second week in the thrombophlebitic or gonorrheal varieties. The course of the illness, under purely conservative treatment, may show marked improvement within a short time, may remain unchanged, or may manifest a turn for the worse. Nevertheless, only if distinct signs of pus accumulation (limited areas of tenderness, tumor formation, high polynuclear leukocyte count, 90 to 95 per cent.) develop, is vaginal examination indicated.

Local Foci.—Should a well-defined area of fluctuation be noted in the parametria (rectovaginal septum), in Douglas' culdesac, or extraperitoneally above Poupart's ligament, the pus focus is to be incised and drained after exploratory aspiration. The same treatment applies to foci elsewhere (subcutaneous, subphrenic, intramuscular abscesses, pyonephroses, etc.). Abscess or exudates are a favorable sign, unless multiple or in vital organs.

In case of severe and protracted hemorrhage from the uterus, usually due to retention of placental rests, I agree with De Lee, that repeated packing of the uterus with iodoform gauze is preferable to curettage in the presence of infection. Great care must be exercised not to dislocate the uterus downward and to avoid rough manipulation when the cervix is seized and the uterus packed. The packing is removed after 24 hours, and is renewed if necessary.

Only in case it is evident that the entire placenta or most of it is retained (producing infection and profuse foul discharge), and it becomes evident that it will not be expelled after repeated intra-uterine tamponade, does manual removal come into question. If an attempt at this fails, vaginal hysterectomy should be performed.

If fibroids have been noted during or after labor, signs of infection may signify necrosis of these growths. Hysterectomy may be indicated (page 531) to forestall a true puerperal sepsis.

Serum Therapy.—In one class of cases only do I attempt to assist a purely symptomatic treatment by serum therapy. That is in the extremely virulent and fatal cases of general streptococcemia in which a positive blood culture is obtained early (third to ninth day), the general symptoms are severe, and all pelvic signs are absent. Under all the usual forms of treatment, these cases

die in from 14 to 16 days. Occasionally such a case is saved by the use of anti-streptococcus serum. The only serum that appears to be of any value is that prepared by the New York Board of Health, a polyvalent serum of which 50 to 100 c. c. (5i ss-iii oz.) are given subcutaneously every 2 days for 3 doses, the uterus being packed with gauze immersed in the serum.

Other Forms of Treatment.—Within but a few years it was the routine treat-

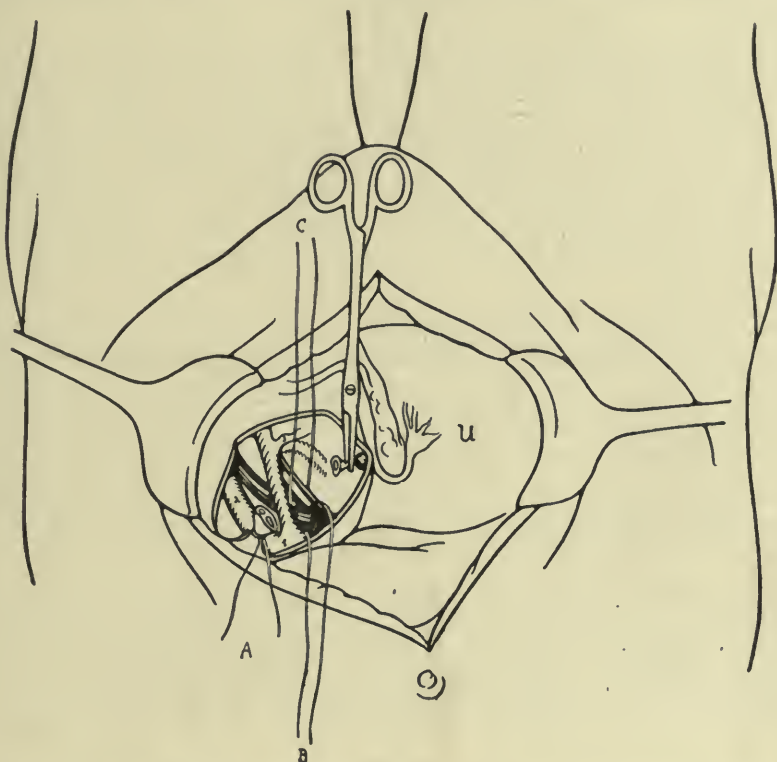


FIG. 48.—LIGATION OF PELVIC VEINS FOR THROMBOPHLEBITIS. The patient lies in steep Trendelenburg posture; the uterus (U) has been pulled over to the right. The left broad ligament has been opened by ligating the ovarian vessels (ligature A) above the thrombus which is seen in the grasp of the artery clamp), cutting the infundibulopelvic ligament, and bluntly separating the peritoneal folds. In the depth appears the common iliac artery (1), dividing into the external (2) and internal iliac. The uterine branch of the latter is seen crossing the ureter at 3. Beneath the arteries are the veins. A ligature (B) has been passed around the common iliac vein, another (C) around the internal iliac vein.

ment in every case of puerperal infection to irrigate the uterus with sterile water, 50 per cent. alcohol solution, or diluted tincture of iodine. Intra-uterine douching for foul lochia has been and still is being performed unnecessarily. When retention of parts of the placenta was suspected, manual or instrumental exploration of the uterine cavity was practiced and is still unduly popular. Almost daily we see cases of mild and strictly local infection converted into fatal types by this unjustifiable procedure. To-day the majority of obstetricians still adhere to this practice in cases of uterine bleeding.

Operation has been advocated in cases of early puerperal peritonitis (drainage, hysterectomy, or both combined). The results are disappointing. Intramural abscess of the uterus has been treated by early abdominal incision and drainage (Harrigan, 6); these cases usually recover if treated expectantly. The abscess is either absorbed or may be more safely opened after weeks or months have elapsed. The same criticism applies to the operative treatment of puerperal pus tubes or ovarian abscesses, if transperitoneal abdominal incision is employed.

The aeme of radicalism, now happily on the decline, was shown by those who advocated early hysterectomy to forestall the spread of beginning puerperal sepsis. These operators attempted to limit this intervention to virulent streptococcus infections, before they had extended beyond the uterus. This treatment has fallen into disrepute because, on the one hand, in many cases general blood infection had occurred and the outcome was fatal, and, on the other hand, the suspicion could not be disproved that a mutilating operation had been unnecessarily performed.

LIGATION OF THE PELVIC VEINS (ovarian, uterine, round ligament, iliae, etc.), in cases of chronic pelvic thrombophlebitis, through a median abdominal incision, is at present enjoying considerable vogue. The indications are a chronic course, repeated chills, veins palpable in the broad ligaments, negative blood culture. The operation is still *sub judice*; it is at least comparatively harmless, though the results are apparently equaled by conservative treatment. The statistics of Vanverts and Pancot (27) show 49 deaths in 82 cases.

TECHNIC.—Through a median incision below the umbilicus the pelvis is made accessible (steep Trendelenburg posture). The ovarian veins are palpated in the broad ligament. If thickened, the overlying peritoneum of the broad ligament is split and the vein followed upward above the level of the thrombus. At this site the vein is severed with the cautery between 2 ligatures. The uterine, internal iliae, and even the common iliaes and vena cava have been tied. The peritoneum over the vessels is sutured and the abdomen closed without drainage (Kovnatsky).

Many other forms of treatment, such as Credé's injections of collargol, inunctions with this silver preparation (15 per cent. ointment), bichlorid of mercury, or formalin used intravenously, etc., have been advocated. Some have proved harmful, others merely of no curative value. Vaccine therapy is inefficient.

DRUGS IN OBSTETRICS

Drugs play a somewhat subsidiary rôle during gestation, labor, and the puerperium. Nevertheless, partly because individual idiosyncrasy may be altered by the pregnant state, and partly because certain remedies, usually quite

harmless, prove toxic or are poorly borne at this time, the unwary may meet with unpleasant surprises unless duly warned.

During Pregnancy.—**CATHARTICS.**—Strong vegetable cathartics, such as castor oil, colocynth, and aloes are poorly borne. They may produce abortion. Cascara sagrada, phenolphthalein, or sulphur and cream of tartar are useful. An occasional dose of mild saline laxative (citrate of magnesia, etc.) will do no harm.

URINARY ANTISEPTICS.—Urotropin (hexamethylenamin) is employed in pyelitis or cystitis (gr. v, 0.3 gm., 3 times a day). Where this fails to relieve, salol (gr. v, 0.3 gm., 3 times a day) should be substituted, unless gastric symptoms contra-indicate. Tincture of hyoseyamus (gtt. 15 to 40) every 4 hours helps to control too frequent urination or tenesmus.

HYPNOTICS are frequently indicated. Bromids (gr. x to xv, 0.6 to 1.0 gm.) at night may suffice. An occasional dose of veronal (gr. v, 0.3 gm.) or a similar quantity of medinal will be of service; these, however, are habit-forming drugs.

THREATENED ABORTION manifests itself by pain, spotting, or bleeding. In addition to rest in bed, a rectal suppository consisting of eodein, gr. i (0.6 gm.), extract. belladonn. gr. $\frac{1}{8}$ (0.008 gm.), butyr. cacao q. s., should be given every 3 to 4 hours until the patient becomes sleepy. The opium effect is kept up for 1 or more days unless it becomes evident that abortion is inevitable. Viburnum and similar drugs are less efficient.

NAUSEA AND VOMITING.—Delafield's mixture—cerium oxalate, gr. v. (0.3 gm.); subnitrate of bismuth and sodium bicarbonate aa gr. x (0.6 gm.), added to $\frac{3}{4}$ viii of milk—kept icy cold, and taken in tablespoonful doses every half hour, is often effective in mild cases. Some cases of intractable vomiting are promptly relieved by thyroid extract, gr. i (0.06 gm.) taken morning and evening. If tachycardia develops, the thyroid must be stopped. Occasionally gr. ii to iv (0.12 to 0.25 gm.) of aristol given in capsules, 1 every 4 to 6 hours, proves of use.

ANTILUETIC TREATMENT.—Salvarsan or neosalvarsan is well borne by pregnant women. One or more intravenous injections, gr. v to vi (0.3 to 0.4 gm.) controlled by the Wassermann reaction should be given at any period of pregnancy, as soon as primary or secondary lesions develop (chancre, condylomata, mucous patches, etc.). The treatment is particularly successful in cases of latent syphilis marked by no symptoms except repeated abortions or stillbirths (Wassermann test positive!). Subsequently mercury and iodids are indicated as in the non-pregnant state.

DRUGS CONTRA-INDICATED.—Especially contra-indicated throughout pregnancy are large doses of strychnin, quinin (except in malaria), or ergot.

During Labor.—**MORPHIN.**—Morphin is of sovereign value if properly employed. It relaxes cervical spasm; first inhibits and then (as its effect wears off) regulates irregular and ineffective pains; and overcomes fatigue and exhaustion, by affording a few hours of rest. It should always be given before a

patient threatened with uterine rupture, etc., is transported to a hospital. If a patient is in labor for hours, has ineffective "nagging" pains, becomes restless and excited, and shows no adequate dilatation and advance, a single dose of gr. $\frac{1}{4}$ (0.016 gm.) should be injected subcutaneously, provided there is no absolute dystocia.

PITUITRIN.—Pituitrin, the extract of the posterior lobe of the hypophysis cerebri, bids fair to make the use of low forceps unnecessary in many instances. It is a most effective drug, **but must be employed with great caution!** I prefer Parke Davis' extract, but any standard preparation may be used. Pituitrin intensifies labor pains for $\frac{1}{2}$ to $\frac{3}{4}$ hour, without, as a rule, producing tonic contractions if employed in the proper manner.

IN THE FIRST STAGE, its use is usually contra-indicated. Exceptionally a small tentative dose (\mathfrak{M} vii, 0.5) may be given after insertion of a metreurynter for the induction of labor, if the pains remain weak and infrequent. If the cervix is not fully dilated (in multiparæ, without serious dystocia, if less than 3 fingers dilated), severe tetanus uteri, necessitating full anesthesia, has been noted by me in several instances. Rupture of the uterus, consequent upon its injection, has been reported (Herz, 8).

IN THE SECOND STAGE the value of this drug cannot be overestimated. **It should not be employed to overcome serious mechanical dystocia.** Its application is found mainly in the stimulation of weak, irregular, or infrequent pains, where, heretofore, forceps delivery was indicated. As a typical example may be cited a primipara with occipitoposterior presentation, thoroughly exhausted by her prolonged first stage. Cervical dilatation has taken place, after rest has been obtained by means of morphin; the head lies in the transverse diameter in mid-pelvis; the pains are ineffective. Formerly a difficult medium forceps would have been necessary. To-day, we prepare for forceps delivery and anesthesia, and then inject \mathfrak{M} xv (1.0) of pituitrin subcutaneously. Within 3 to 5 minutes the uterine contractions become strong and regular, and the head rapidly descends to the vulva. Quite often, spontaneous rotation and expulsion occur; if not, instead of a difficult and dangerous medium forceps, a simpler low application to a rotated head terminates the delivery. Again, if the head is arrested for some time on the perineum, because of cessation of the pains, an injection of pituitrin, alone or combined with a slight episiotomy incision, effects delivery, within a few minutes (Humpstone, 9).

The *precautions* to be observed are: Do not use pituitrin before the cervix is dilated. Always prepare for immediate operative delivery and be ready to anesthetize the patient at once, should spastic uterine contractions or too strong pains develop. Auscultation of the fetal heart should be practiced every 10 minutes; if the child's condition becomes alarming immediate delivery is instituted.

IN THE THIRD STAGE pituitrin is not indicated. At times, if this drug is given late in the second stage, the expulsion of the placenta is delayed. Hour-glass contraction has not been observed by me. The retention of the placenta

has produced no alarming symptoms; a little extra patience (waiting 30 or 40 minutes) was rewarded by spontaneous expulsion or an easy Credé maneuver.

Post Partum.—**ERGOT.**—Ergot should be exhibited as soon as the entire placenta has been expelled or removed. If the patient is conscious, i to iss 3 (4 to 6 c. c.) of the fluid extract is given by mouth. Patients, still under the influence of an anesthetic, receive ℥ xv (1.0) of aseptic ergot or ℥ 20 of ergotole subcutaneously. The dose may be repeated if the uterus relaxes unduly.

Ergot is strictly contra-indicated before the placenta has been expelled.

During Lactation.—As shown by clinical experience and by experimental research, great individual variations are noted in the excretion of drugs through the breast secretion. Whenever the breast-fed nursing shows abnormal symptoms, especially colic and diarrhea, the attending physician must consider what drugs the mother is receiving. Ergot, cascara, magnesium sulphate most commonly produce symptoms, though in many instances they may be continued for days or weeks without affecting the baby.

Large doses of morphin may also influence the infant (causing somnolence or coma); therefore, this drug must be exhibited with caution.

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CHAPTER XVI

SURGERY OF THE HAND AND FOOT

KARL CONNELL

CONGENITAL DEFORMITY OF THE HAND AND FOOT

Ectrodactylism.—Congenital deficiency of the fingers and toes arises from maldevelopment and from intra-uterine accidents, such as amputation by amniotic bands. These defects rarely call for surgical interference except to complete, for cosmetic reasons, the amputation of some rudimentary part.

Polydactylism.—The presence of supernumerary digits more commonly calls for surgical interference, both for cosmetic reasons and because of mechanical inconvenience. Most commonly these rudimentary digits bud from the first metacarpal bone, infrequently from the fifth metacarpal, and least commonly they occur by bifid development of other digits of the hand and foot. In plotting the amputation, recourse should be had to a radiograph, and the underlying portion of rudimentary metacarpal bone should be resected.

Syndactylism.—Webbed fingers and toes may be of any degree from a slight exaggeration of the normal web or a broad, thin, loose membrane between 2 or more adjoining fingers, up to that degree where the entire side of the digits is fused together by both fibrous and osseous union. The middle and ring fingers are most commonly united.

TREATMENT.—If the condition is of such degree as to be unsightly, or if it interferes with the free use of the fingers, surgical interference is warranted. When the membrane is loose, separation is readily effected.

It does not suffice merely to divide the membrane up to or beyond the level of the normal web, as the interdigital scar promptly contracts and reestablishes the web. To prevent the web reforming a section of skin susceptible of stretching must cover the scar at the level of the normal web.

This may be obtained by lifting from the palmar surface of the web a V-shaped flap, the base of this flap being at the line of normal web. The denuded dorsal layer of web is now incised by a longitudinal cut extending between the knuckles posteriorly. The palmar triangular flap is dragged through the dorsal

slit and sutured, covering the raw area between the knuckles. The distal portion of the web is severed, separating the second and third phalanges, and the raw edges lateral to each finger are sutured.

When there is no web, but the fingers are bound closely together, recourse should be had to a radiograph to determine whether there is osseous fusion. When broad osseous fusion exists, little can be accomplished, except ablation of that finger which is the more rudimentary, to improve the remaining finger cosmetically. Such ablation should also include excision of the head of the metacarpal bone of the amputated finger.

When union is by soft parts only, the fingers may be separated. Difficulty arises, however, in that in close union there is not sufficient skin to cover the denuded area of both fingers after separation. Therefore, the operation should be designed to cover the most useful finger completely, leaving the other to be covered by transplants of skin of full thickness from other parts of the body. It is well to leave an equal amount of palmar skin attached to each finger, that is, to make the palmar dissection an equal distance from each finger. But from the dorsum of the less useful finger a flap is raised which, when the 2 fingers are disconnected by dissection of the connected soft parts, will entirely cover the most useful finger. The denuded area of the other finger may be primarily covered by a Thiersch graft; usually this results in scar contracture. A Wolff graft, if it lives, is most advantageous. The prepuce, when available, is the best tissue. One may have recourse to a 2-stage transplant, for which the skin most available is that of the opposite iliac region. A flap of skin is raised by 2 parallel incisions, and the finger is thrust beneath the flap so that the denuded area lies against the raw surface of the flap. The hand is bound in place for 12 days, after which that portion adherent to the finger is cut free from the abdominal connection. The abdominal wound is sutured, and the wad of skin adherent to the finger is gradually molded into place.

The operation so commonly diagrammed in textbooks (Didot's), dissecting a palmar flap from one finger and the dorsal flap from the other finger, is successful only when the connection between the 2 digits is fairly loose and there is an abundance of skin in the web to create the 2 wide flaps needed to cover the denuded area of the 2 fingers.

Macroductylia.—Overgrowth of one or more fingers may require ablation or amputation for cosmetic or functional reasons. Usually the etiological factor, namely, lymphangiectasis, deforms the hand as well, and successive ablations must be done.

Congenital Contraction of the Fingers.—This condition usually affects the band of skin and fascia on the flexor aspect of the little finger, less commonly the ring or other fingers. Treatment is considered under the analogous acquired deformity next considered.

Club hand and club foot are considered together with other congenital deformities in the chapter on Orthopedic Surgery (Vol. II, Chap. IV).

ACQUIRED DEFORMITY OF THE HAND AND FOOT

Flexion of the Fingers from Scar.—Scar tissue on the palmar surface of the finger becomes thickened from exposure to constant trauma and tends more to contract than elsewhere on the fingers. A disabling degree of flexion deformity at the first interphalangeal joint often results. The possibility of such end results should be borne in mind when operating on the fingers and the incision should not be placed in the median line nor cross the flexion creases, but should be to one side and be broken at the creases by intervening bridge of elastic skin.

TREATMENT.—Attempts to stretch or to absorb scar tissue by passive motion, massage, and other therapeutic measures usually result in further contracture. With recent scars or in the congenital form of contraction, the adjoining skin may become somewhat mobilized by motion and splinting, but in contracture of long standing the scar tissue must be removed and the denuded area filled with normal skin. In addition it may be necessary to section the shortened capsule of the first interphalangeal joint. If feasible, the skin from each side of the finger should be loosened and united across the raw area. Occasionally it is necessary to place longitudinal incisions or gores on the lateral aspect to allow the flaps to slide forward.

When the scar to be removed is extensive and the gap cannot otherwise be filled, the surgeon has recourse to skin transplantation. For this purpose, to avoid recurrence of contraction, full thickness grafts must be used, either Wolff grafts or 2-stage transplants of the patient's own skin. In the male an ellipse from the sheath of the penis makes an excellent graft, as it more commonly remains viable than other Wolff transplants. However, the preferable method of filling extensive defects is by 2-stage transplantation of a flap. For example, a trap-door flap of skin is raised from the abdomen in the opposing iliac region. This flap is sutured to the raw area of the finger, and the hand and arm are bound securely across the abdomen by adhesive strapping or a plaster corset for 12 days. The hinge of the flap may then be cut free from the abdomen, and the hand and arm released from restraint, carrying a viable transplant on the finger. These transplants show little tendency to contract. After 6 months or a year they may be readjusted for cosmetic reasons or stretched to fill further defects.

Dupuytren's Contraction of the Palmar Fascia.—This deformity arises from chronic inflammatory thickening of the palmar fascia. It is seen most commonly in men past middle age and where trauma may have acted as a chronic irritant.

Anatomically the palmar fascia consists of 3 parts, a central thick portion and 2 lateral expansions—thin sheets which cover the thenar and hyperthenar prominences respectively. The middle section of the fascia is thick and is closely bound to the skin by fibrous trabeculae. Down each of the 4 fingers it

sends 3 prolongations. The median prolongation proceeds along the palmar surface connected with skin until it is lost in the pulp of the distal phalanx. The 2 lateral slips pass around the sides of the first phalanx and are inserted into the dorsal surface of the first and second phalanges.

The section of fascia most commonly affected in Dupuytren's contraction is that which sends prolongations to the ring finger, next the section to the little finger, less commonly the middle and index finger. In extensive contracture of many years' standing, all the fingers are bound into the palm, the palmar skin is atrophied and wrinkled, and secondary changes are present in the bones, tendons, and joints of the hand.

The first indication of the deformity is a thickened band, usually at the base of the ring finger, and inability to fully extend the finger. After some months or years the first phalanx is gradually flexed and the second phalanx also is drawn into the palm; the third phalanx remains extended and is susceptible of full passive motion, although limited in active motion. The other fingers gradually become flexed until in extreme cases the only useful function retained to the hand is ability to grasp objects between the thumb and forefinger.

TREATMENT.—The condition is to be improved or cured only by removal of the thickened section of fascia. Such palliative measures as massage and splints only hasten the contraction. Such minor operative measures as subcutaneous division of thickened fibers invite prompt contracture of the cicatrices.

In excision of the contracted fascia, the principal difficulty lies in the fact that the skin of the palm has become so shortened that the wound cannot be covered by normal palmar skin. The cicatrices are liable to contract. The preferred operation is to incise across the palm just distal to the main transverse crease, with an extension up the ulnar border of the hand. A triangular flap of palm is reflected toward the thumb, including skin and palmar fascia, dissecting these as a whole from the tendons and other deep structures. The palmar fascia is now excised from the cutaneous flap, and the extensions of the palmar fascia to the fingers are followed up beneath the callosity at the base of the finger and are excised. The flap is now replaced. If it is deficient to cover the soft part without tension, a skin transplant must fill the gap. This may be obtained, for example, from a flap of skin raised from the opposite side of the abdomen and sutured to the hand, which is immobilized across the abdomen. At the end of 12 days the flap has become firmly seated in the palm, and the pedicle to the abdomen is cut. These full thickness transplants of coarse skin effectually fill the palm and prevent cicatricial contracture.

Trigger's Finger: Lock or Snapping Finger.—This affection of the finger is characterized by a momentary catch in one finger as it is actively extended from the flexed position. The finger becomes momentarily locked, then suddenly, by a strong effort at extension, it snaps into full extension in proper relation with the other fingers. This catch on extension may occur only occasionally; and it may also occur on flexion. The mechanics of the condition is that the sliding flexor tendon fits the sheath too snugly at some point, either from an abnormal constriction of the sheath at this point or from bulbous enlargement in the

tendon itself. The binding usually occurs beneath the callosity at the base of the proximal phalanx. The binding is caused usually by chronic inflammatory thickening of the sheath at this point from pressure. By palpating the length of the sheath as the snap occurs, the point of binding can usually be detected as the tendon suddenly slips beneath the palpating finger at this point. Frequently the patient has already located the catch when the surgeon is consulted.

TREATMENT.—If the condition is of recent origin, it often yields to rest and warm applications. When chronic, the tendon sheath should be opened, usually at a point beneath the callosity at the base of the finger. A longitudinal median incision into the tendon sheath over a distance of 1 cm. is made at this point, when the lock will usually be found to have been relieved, even when no pathological condition can be detected. If the tendon presents an enlargement, this is pared off, or a sesamoid bone may be detected and enucleated. Occasionally the cause of the bulbous enlargement is a minute ganglion which disappears on incision. The sheath is left open, the skin only being sutured. Active motion is encouraged after the first day.

Mallet finger is considered under Injuries to the Tendons.

Ingrowing Toe-nail.—Ingrowing toe-nail most commonly occurs at the distal end of the mesial border of the great toe-nail. Less commonly the side toward the second toe is affected and only rarely the other toes and fingers. It is occasioned by ill-fitting footgear, and by cutting the toe-nails too short and rounding the corners, thus permitting the soft parts to be crowded over the edge. Usually the nail is markedly convex, a distal corner curls into the soft parts, and the epidermis at the point of pressure becomes eroded. There is a discharge of seropurulent infected exudate and exuberant granulations appear from the sulcus. The surrounding soft parts become thickened from chronic inflammation. The condition is painful and tends to recur after it has been controlled by palliative measures.

TREATMENT.—When the condition is recent and the soft parts are not infiltrated, the lateral wall of the nail may be drawn aside by adhesive strapping and the eroded derma protected by a bit of tin foil slipped under the nail until the nail has grown beyond the cutaneous pocket; also, the nail, if of exaggerated convexity, may be rendered less convex and more pliable by a deep V-shaped notch in the free margin or by scraping or rasping thin the central section of the nail.

Avulsion of the whole nail has been practiced, but it is preferable to perform a plastic operation which leaves the most of the nail-bed protected. This operation has as an object, first, the removal of the lateral portion of the matrix so as to narrow the nail; and, second, the removal of the hypertrophic soft parts of the lateral wall so that they will not again be crowded over the nail.

A common operation is that of Cotting, who amputates in one slice the entire side of the toe. This effectually cures the ingrowing nail, but denudes an area which may remain raw and tender for 5 weeks. I have elaborated the following

from the von Bergmann procedure. It yields the most rapid cure of the many procedures we have employed at the Roosevelt Hospital:

TECHNIC OF OPERATION.—The toe is rendered bloodless by clastic ligature and anesthetic by local infiltration. An incision is made as shown in the accompanying diagram (Fig. 1), reflecting laterally a flap inclusive of as much subcutaneous tissue as is possible without including any of the epithelium of the nail sulcus. The flap is dissected well beyond the proximal and lateral margins of the nail. The lateral margin of the nail is excised (Fig. 2), together with the nail sulcus, including all the epithelium and the surrounding scar tissue. The matrix of the nail is excised more widely (Fig. 2), care being taken that it is excised close to the periosteum of the phalanx beneath and from the fat at its proximal and lateral margins, without leaving behind any shred of epithelium. The flap of skin is now laid in place, completely covering the former site of the excised nail sulcus and nail matrix. It is bandaged into place without suture to insure free drainage. The patient usually can walk without limp the second day and the toe is healed in 8 or 10 days.

Corn, Clavus.—A corn is a localized hypertrophy of epidermis, usually occurring on the toe or the foot at an area subjected to constant friction and pressure, as from ill-fitting shoes.

When situated on an exposed surface, the corn is dry and hard; when between the toes, it becomes softened and macerated by perspiration. A corn tends to become painful and at times disabling. In pathology it differs from a callosity, first, in persisting after the cause of hyperplasia is withdrawn; second, in shape, in that the horny layers, while flattened on the surface from pressure, project into the deeper layers of skin as a truncated cone; third, beneath this cone the stratum mucosum becomes irregular and tends to be thrown into a series of papillæ, whereas the deeper layers of a callus are normal. A bursa tends to develop in the subdermal tissue, as it does under all points of pressure.

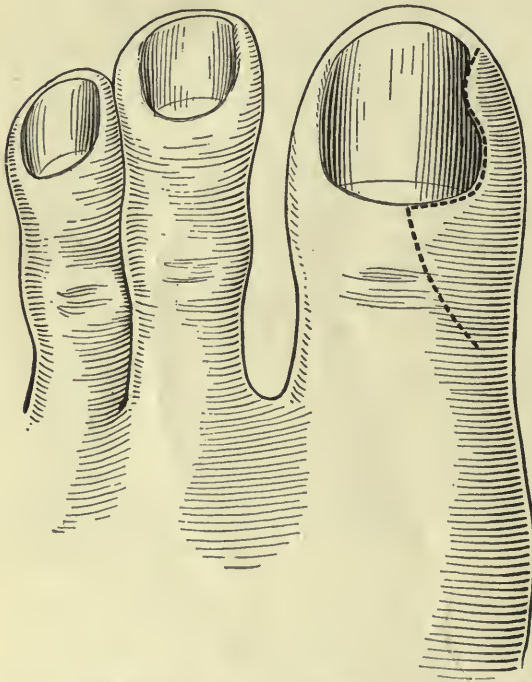


FIG. 1.—RESECTION OF NAIL MATRIX FOR INGROWING TOE-NAIL (1). Dotted line shows placement of incision for reflecting the skin flap. (Connell modified von Bergmann operation.)

Symptoms arise from the pressure of the horny cone on the tissue beneath, and from various inflammations of the bursal sac, commonly known as a bunion.

In paring the surface, the papillary layer is often accidentally incised, opening the underlying tissue to infection.

TREATMENT.—Recent corns may be regarded as callosities, which will disappear if the irritation is removed. Corns of long standing may be treated palliatively by protection or radically by excision. The palliative measures consist in the removal of the lenticular mass of horny layer, either mechanically by paring with knife, or chemically by softening with epithelial solvent, such

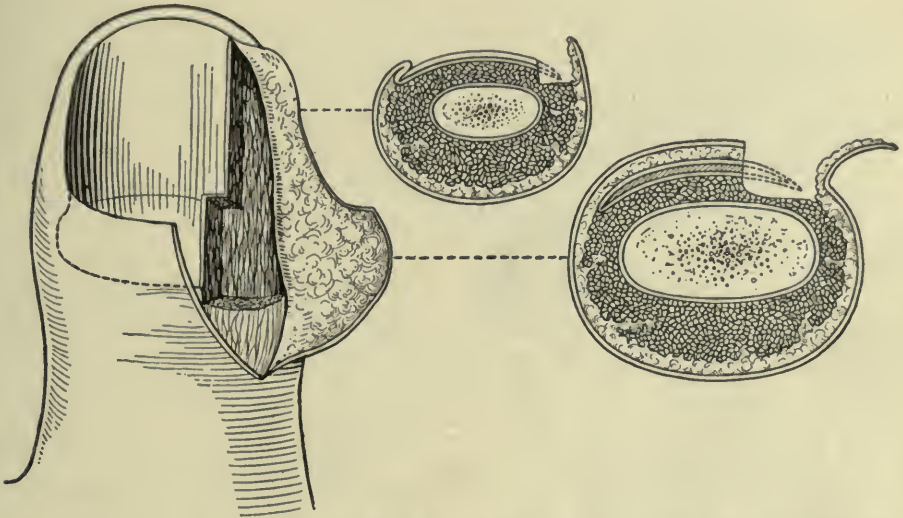


FIG. 2.—RESECTION OF NAIL MATRIX FOR INGROWING TOE-NAIL (2). Lateral nail sulcus has been dissected out. An oblong block of tissue embracing the nail matrix and the underlying tissue has been excised. The skin flap is ready to be replaced entirely covering the denuded area.

as salicylic acid, 10 per cent., in collodion in repeated applications. In paring the corn, done so frequently without regard to asepsis, the papillæ of deeper tissue may be cut and infected, and cellulitis and suppurative bursitis may result. On accidentally exposing the papillary layer, the wound should be sterilized by tincture of iodine.

When the corn is persistently painful, it may be assumed that a bursa exists beneath the corn. Unless the bursa as well as the corn is removed the area will remain painful. Therefore, when a corn has proven persistent and disabling, the proper procedure is to excise the corn as a whole, together with the underlying bursa, much as if one were coring out an apple.

If possible, the edges of the wound should be approximated by suture, when it will be healed in about 5 days; otherwise, it must be healed by granulation requiring about 12 days. In either case the disability in the convalescent period does not equal that of the original corn. Surgical excision of corn and bursa is an operation which is not practiced by the skilled surgeon to the extent his art

demands. The "removal of the corn by the roots" by the chiropodist consists merely in peeling off the stratum corneum from the papillary layer of the skin.

Bunion.—A bunion is a bursal sac developed under an area of constant pressure in the foot. The largest and most common bunion is that developed to the mesial aspect of the head of the first metatarsal bone. It is usually associated with hallux valgus.

TREATMENT.—Palliative measures are, first, relief from excessive pressure

by proper footgear and bunion rings; second, local counterirritation, as by iodine and ichthyol. An acutely distended bursa may be aspirated for temporary relief of pressure symptoms. The radical treatment consists in the removal of the bursa. In excising the bunion of the great toe, the prominence of the metatarsal bone should be removed or the position of the great toe corrected. Otherwise, the bursa will be redeveloped by the original excessive pressure.

Hallux Valgus.—Hallux valgus consists of a lateral or outward deviation of the great toe at the metatarsophalangeal articulation. The deformity is one usually induced by ill-fitting footgear. Moderate degrees of the condition are common in individuals past middle life. Even a slight degree of abduction tends toward outward subluxation of the joint and presents the head of the metatarsal bone so prominently at the mesial border of the foot that a bursa commonly develops. This bunion is present in

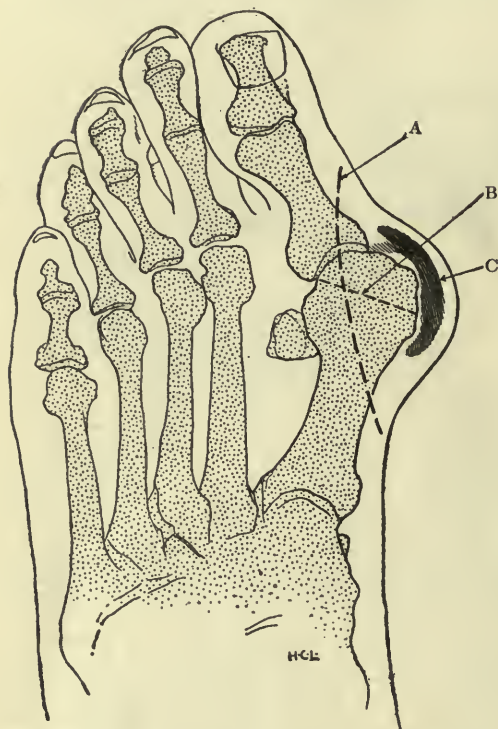


FIG. 3.—ARTHROPLASTY FOR HALLUX VALGUS. A, Line of skin incision; B, line of excision of the head of metatarsal bone; C, position of bunion (occasionally communicating with joint). The figure also shows the usual adduction of the first metatarsal bone, and the abducted position of the great toe; also the misplacement of the sesamoid bones which mark the position of the flexor and extensor tendons of the great toe.

practically all cases of hallux valgus of sufficient degree to warrant treatment. Occasionally the abduction and subluxation of the great toe are so extreme that it lies almost transversely across the dorsum of the smaller toes. The metatarsophalangeal joint becomes gradually modified until it faces outward as well as forward, rendering it mechanically impossible to replace and hold the toe in proper line with the foot without arthroplasty. From the erosive changes induced by the subluxation, the joint is subjected to various forms of chronic arthritis. When the bursa communicates with the joint, as it occasionally does,

the joint is liable to extension from chronic bursitis and acute infections of the bunion.

TREATMENT.—Slight degrees of deformity may be ignored or corrected by rational footgear and by orthopedic splints. Moderate deformity, with symptoms arising from the bunion, warrants the removal of the bunion and bony prominence. Extreme or disabling degrees of the deformity should be corrected by arthroplasty.

When a bunion over the mesial prominence of the head of the metatarsal bone is the principal factor in the symptomatology, operation is as follows:

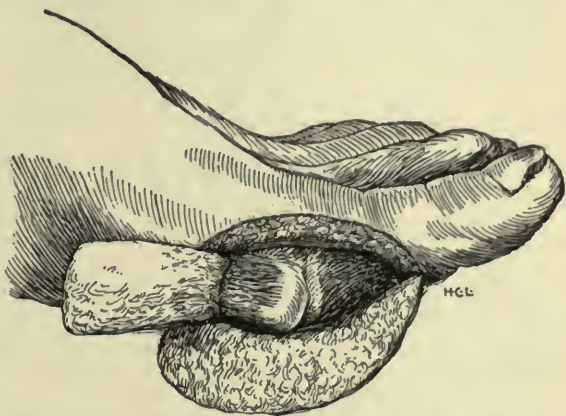


FIG. 4.—ARTHROPLASTY FOR HALLUX VALGUS. Showing the cutaneous flap reflected toward the sole and the deep flap including the bursa reflected proximally from the joint. The head of the metatarsal bone is about to be exposed by dislocating the great toe outward to permit of resection.

A curved incision 2 in. long is placed mesial and dorsal to the joint, the concavity toward the plantar surface, so that the subsequent scar will not be at a point of pressure. The flap is dissected from off the bursa, and this is excised. The prominence of the metatarsal is now excised by splitting off with an osteotome the mesial third of the head of the metatarsal bone, smoothing it to the plane of the shaft of metatarsal bone. The dorsal tendon, together with its sheath, may now be transplanted to the inner or mesial border of the first phalanx for the purpose of gradually correcting the abduction of the toe. Rough edges are removed by rongeur and the skin sutured. Walking should be encouraged after the third day.

Extreme cases of deformity are to be cured only by refacing the joint by arthroplasty. Additionally, the denuded end of the bone should be covered by soft parts to secure a mobile joint. Arthroplasty may be performed from the mesial side (Mayo method) or by incision between the first and second toe (Fowler). In the former arthroplasty the bunion and as much of the surrounding subcutaneous tissue as can be included in the flap are turned into the joint, instead of being excised as in the bunion operation.

ARTHROPLASTY: MAYO TYPE.—The skin incision extends from the inner aspect of the middle of the proximal phalanx in a long curved sweep dorsal to the joint, terminating at the inner border of the foot $1\frac{1}{2}$ in. proximal to the joint. This flap is dissected from off the bursa toward the plantar aspect. Next an oblong flap of subcutaneous tissue is reflected proximally from the inner border of the foot, beginning at the middle of the first phalanx and ending in a base attached 1 in. proximal to the joint. This flap includes the subcutaneous fat, the bursa, and the internal ligament of the joint. If the bursa is diseased,

it should be excised from the flap. The toe is now dislocated outward or toward the fibular border.

Half an inch of the head of the metatarsal bone is removed by saw, making a new raw joint surface which looks forward and slightly inward. The toe is now replaced on this surface and inspected to see if it holds in perfect alignment without any pressure. If the toe still deviates, the joint is faced more

internally. The toe is now redislocated and the free corners of the flap of subcutaneous tissue are transfixed by traction sutures and the flap as a whole is drawn across the denuded metatarsal bone, passing the sutures out between the great and the second toe and tying them here over a piece of gauze. The skin wound is sutured, and the toe splinted by gauze dressing. Walking should be encouraged early, even after the sixth day, although it is several weeks before there is serviceable restoration of function.

Hammer-toe.—Hammer-toe is the result of a flexion deformity of the proximal interphalangeal joint. As a result, the second and third phalanges are directed like a hammer at the plantar plane of the foot, the last phalanx being either slightly flexed or crowded into hyperextension. The toe, as a whole, is thrown into hyperextension at the metatarsophalangeal joint. The ligaments and joint surfaces become modified to the position enforced by the fixed flexion of the second phalanx, and various reactions to pressure develop, such as painful corns and bunions on the dorsum at the prominent inter-

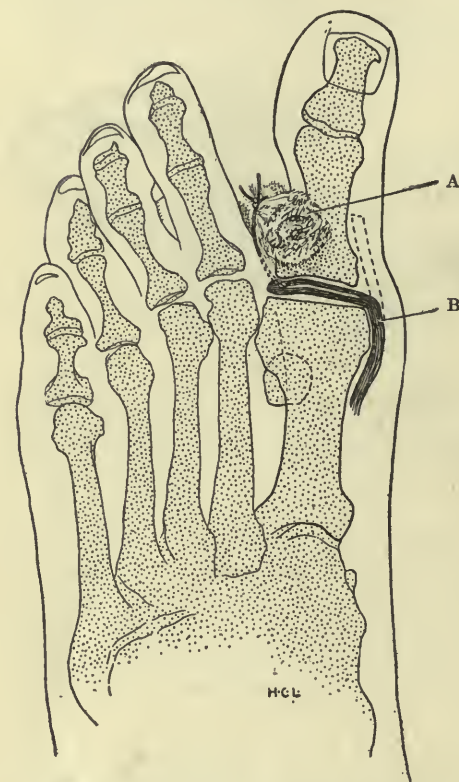


FIG. 5.—ARTHROPLASTY FOR HALLUX VALGUS.

—Flap of soft parts B drawn over the denuded end of the metatarsal bone by transfixion sutures which are tied over roll of gauze A. Adduction of metatarsal bone and abduction of great toe have been corrected and tendons, as indicated by position of sesamoid bones, are again normal.

phalangeal joint, also corns on the tip of the toe, and deformity and inflammation of the toe-nail. When the joints become fixed and the condition disabling, operation is warranted.

TREATMENT.—Non-operative measures, such as forcibly correcting the position of the toe, or holding it for a time by splints, are ineffective to correct the deformity. Slight deformity may be corrected by cutting subcutaneously across the plantar aspect of the first interphalangeal joint, severing the flexor tendon and plantar fibers of the capsule.

The most rapidly satisfactory functional result is secured by amputation of the deformed toe at the metatarsophalangeal joint. With the second toe, however, amputation is not advisable, since loss of the toe allows further abduction in the hallux valgus which so commonly accompanies this deformity. When desirable to retain the bulk of the second toe or of the third and fourth toe, as for cosmetic reasons, the distal half or more of the proximal phalanx may be excised subperiosteally through a lateral incision, and the position of the toe corrected.

SPECIAL INJURIES OF THE HAND AND FOOT

CRUSHED FINGER

The digits, especially the fingers, are the most liable to crushing injury of any part of the body. Moderate lateral pressure at the terminal phalanx may split the nail. Moderate anteroposterior crushing force at the terminal phalanx most commonly causes swelling and subungual hematoma. More severe crushing may result in fracture of the phalanx, usually transversely near its base, and split open the pulp of the finger. A still more severe force results in mangleing and in traumatic amputation.

Split Nail.—Usually the nail is split only at the distal portion. Treatment is instituted against infection and to protect the nail-bed from extension of the split into the matrix, a result which would cause permanent split or ridge deformity of the growing nail. The split should be touched with tincture of iodine, covered with collodion, and protected against further injury by a tin or aluminum guard strapped over the dorsum of the terminal phalanx.

Hemorrhage Beneath the Nail.—The space most commonly infiltrated by the blood and exudate of crushed finger is a space formed by the separation of the proximal growing portion of the nail from the nail matrix. Usually the proximal third of the nail is raised, blackened by the blood beneath, and floated on a tense cushion of exudate. The nail is tender on pressure and throbs when the exudate is excessive or has become infected.

TREATMENT.—The object of treatment is to drain the fluid exudate before it becomes infected and at the same time relieve pressure symptoms. The nail sulcus should be painted with tincture of iodine and the eponychium broken through by a probe, detaching the entire proximal nail wall from the nail sulcus to release the bloody exudate. A moist or ichthyol ointment dressing is then applied. After 3 days the nail-bed has hardened and the proximal loosened half of the nail may be lifted by probe and excised without discomfort. The distal half of the nail, if not primarily loosened, is preserved as a protection to the finger tip by strapping with adhesive tape or by collodion dressing, until finally this portion is crowded off by regeneration of a new nail. Complete regeneration may be expected in 14 to 20 weeks.

Crushed Pulp of the Finger and Compound Fracture of the Terminal Phalanx.

—The finger is cleansed with tincture of iodine and an ointment dressing applied. The lacerations should not be sutured, but allowed to drain freely. The fractures rarely require any special treatment. The entire finger should be protected and splinted for about 8 days by an aluminum gutter or by cardboard.

Traumatic Amputation of the Fingers.—**CLEAN CUT AMPUTATION.**—If the amputation is clean cut, it is advisable merely to surgically cleanse the raw area with tincture of iodine and protect the part with weak mercurial ointment dressing, and await the cicatrization of the stump. This is complete in 3 to 4 weeks. Bone should be sacrificed only when it is bare and projects. Attempts to secure rapid recovery by shortening the bone or by re-amputating at a more proximal level, so as to secure flaps of normal skin for the end of the stump, not infrequently sacrifice the finger's length to a disabling extent. Every fraction of an inch possible should be retained in the finger's length. **This is especially to be urged in treatment of the thumb.** Effort to secure an immediately satisfactory cosmetic result by further amputation and tight suture not infrequently leads to the retention of septic material, to cellulitis, and to suppurative tenosynovitis.

MANGLED FINGERS.—When the amputation is partial and there is considerable mangled tissue distal to the crush, this tissue should be conserved to the utmost. A very small shred of connection will be found not infrequently to carry sufficient blood supply to support half a cubic inch of mangled tissue. This tissue is to be cleansed with benzine or turpentine and painted with tincture of iodine. It should then be moulded into some resemblance of the former finger with as few sutures as possible. Bare bone and bare tendon should be covered in by soft parts, and the cutaneous laceration loosely tacked together by suture. Perfect cosmetic apposition is not advisable, since drainage must be free. The results of such conservation in re-establishing a useful member are sometimes astonishingly perfect. At the end of 8 days it is justifiable to trim away a non-viable part.

WOUNDS OF THE TENDONS

With incised wounds of the fingers, hands, and wrist, no matter how superficially unimportant, the various functions of the fingers should be tested out to establish tendon integrity. If a tendon is found to be severed, the ends should be united by chromic catgut suture before separation has become marked. However, in the presence of sepsis the wound should be allowed to heal and the tendon united by later operation.

Those tendons which do not run in sheaths retract scarcely more than half an inch, while a tendon severed in a long sheath, as, for example, the flexor longus pollicis when severed in the palm, may retract $1\frac{1}{2}$ in. or more.

Severed tendons are best approximated end to end by mattress sutures of fine chromicized catgut. The sheath need not be sutured, only the overlying skin wound is closed. Drainage by a few strands of silkworm-gut may be

established for 24 hours into the subcutaneous layers through an angle of the skin wound, particularly if there is much laceration of tissue. The part is placed at rest and maintained by a splint so as to relax any strain on the tendon.

After 8 days it is desirable to move the tendon gently by passive motion of the finger. Active motion should be commenced by the end of the second week, and full functional excursion gently persisted in by the end of the third week. If too early used, the tendon may part; and if too long immobilized, the functional excursion may be seriously interfered with by organized adhesions.

Subcutaneous Rupture of the Extensor Communis Digitorum Over the Second Phalanx: Mallet or Drop Finger.—This lesion commonly occurs by stubbing the extended finger. The lesion at the time of occurrence may pass unnoticed, but later it is noted that the terminal phalanx cannot be fully extended, remaining in about 45° of passive flexion when the other fingers are straight. The lesion is usually a transverse rupture of the dorsal tendon, about $\frac{1}{4}$ in. from its insertion into the base of the last phalanx. Occasionally the tendon may be torn from the bone. This lesion must be differentiated from fracture into the joint at the base of the terminal phalanx. In the deformity of fracture, usually full passive extension is lost as well as active function. With the tendon rupture, the full passive range of joint motion is not restricted.

TREATMENT.—In recent cases, immobilization with the joint in hyperextension for 10 days occasionally results in restoration of function. However, operative treatment is advisable both in recent and old injury. A dorsal incision $\frac{1}{2}$ in. long is made over the second phalanx, beginning at the last interphalangeal joint. The proximal end of the delicate tendon, about $\frac{1}{8}$ in. wide and as thin as tissue paper, is seen retracted to the middle of the second phalanx. It is carefully loosened and sutured to the shred of tendon still attached to the last phalanx, or to the periosteum of the base of the phalanx. The finger tip is put up in hyperextension on a palmar strip of tin or aluminum. The finger tip is held in this position for 10 days, then on a straight splint for another week before active motion is permitted.

Severed Tendons Over the Dorsum of the Hand and Wrist.—The extensor tendons retract, scarcely ever to exceed $\frac{1}{2}$ in. They are readily recognized and sutured, and immobilized for 10 days with the fingers and hand held in full extension on an anterior moulded plaster splint.

Severed Tendon of the Flexor Profundus Digitorum at the Second Phalanx.—If the proximal end of the tendon cannot be readily grasped, it is sought through a second small incision over the proximal phalanx. The end is threaded back through the sheath beneath the sublimis digitorum.

Severed Flexor Tendons Over the First Phalanx and in the Palm.—When severed at the first phalanx, the end of the tendon is sought by incising through the callosity at the base of the finger. In the thumb and little finger retraction is greater. When severed in the palm, these latter tendons should be sought by incision in the radial and ulnar bursæ respectively, just above the flexor crease of the wrist. The proximal end is then threaded through the length of

the sheath down to the site of severance in the palm, a probe first being passed from the wrist wound into the palmar wound and dragging the tendon through by ligature.

Severed Flexor Tendons at the Wrist.—Extensive incised wounds transversely across the flexion of the wrist are not uncommon. These divide practically all the flexor tendons. The proper repair requires not only surgical technic, but a fresh anatomical knowledge, to find and correctly match the various loose ends of tendons and nerves. The search for retracted tendon ends must often be carried on by longitudinal incision 2 in. or more up the forearm.

TOOTH WOUNDS OF THE HAND

Wounds from the bite of dog, cat, or other carnivora, and especially those inflicted by teeth of men, should be regarded as virulently infected wounds. Mechanical cleansing or weak antiseptic wash is insufficient to reliably cleanse these wounds. In dog bite or when there is suspicion of infection with rabies, the wound should be cauterized with nitric acid. Wounds inflicted by man or cat should be swabbed with liquid phenol (95 per cent. carbolic acid) and this promptly neutralized with tincture of iodine. The wound should not be sutured. Small wounds need not be drained, but when on exploring with the iodine swab it is found that there is considerable laceration of subcutaneous tissue, the wound should be packed with gauze soaked in camphor phenol (Chlumsky's solution). Tooth wounds over the knuckles are considered under suppurative arthritis of the metacarpophalangeal joint (page 597).

NEEDLE IN THE HAND

Of the various foreign bodies which become lodged in the hand, the most common is the shaft of a broken needle. The symptoms are due to infection and to irritation caused by the foreign body. Infection to the degree of suppuration is exceptional, but it is usual to have tenderness, swelling, and local heat during the first week. Thereafter the symptoms are largely mechanical from movement of the needle in the tissue, until the needle finds lodgment and becomes encysted. The needle tends to move, propelled by the various muscles and tendons and to lie parallel with the fibers of these structures.

It may travel considerable distances; therefore, all except recently taken radiographs are unreliable in locating it.

Treatment.—Needles which cannot be felt and which give no symptoms are best left undisturbed pending the development of symptoms. Needles lying in infected tracts and those which can be felt may be attacked without the information of a radiograph. When the needle cannot be felt or is only to be deeply detected, yet disables the fingers or hand, it should be removed. First

the plan of attack must be worked out by several radiographs at different angles, accurately locating the needle shortly before the time of operation. The needle must be located not only in relationship to the bones, but also to the skin surface creases, these being outlined before taking the radiograph by filling them with stiff mercurial ointment. When short operative search fails to discover the needle, immediate radiograph should be taken with several hypodermic needles crossed at various angles, embedded in the wound. Without such orientation, a 5-minute procedure may be drawn out for many hours of fruitless search.

GUNSHOT WOUNDS OF THE HAND

Gunshot wounds of the hand open important fascial spaces and tendon sheaths to infection. Additionally, the penetrating body traverses a soil-contaminated surface and often carries in a portion of skin or gun wad. The weapon is usually of such low power that the foreign body is retained in the tough tissue planes of the hand. The liability to sepsis and tetanus is great.

Treatment.—All gunshot wounds of the hand should be regarded as a possible source of tetanus, and the patient should receive an immunizing dose of tetanus antitoxin. The wound should be cleansed and drained. Tincture of iodine is the best cleanser.

Wider drainage than the missile tract afford is indicated because of the contraction of the tough palmar skin and palmar fascia on the tract. Therefore this should be slit with a fine bistoury, cutting the skin and palmar fascia. The deeper palmar fascia spaces are then inspected for gun wad and other foreign bodies and are cleansed. The wound is packed with mercurial or bismuth ointment gauze, and left open. If the wound be through and through, drainage is more readily established. The tract is swabbed through with iodine, and drainage is instituted by passing half a dozen strands of silkworm-gut threaded on a probe. Tendons, if severed, should be repaired by secondary operation after the wound has healed, since immediate suture in the face of lacerated and infected tissue often leads to sloughing of the tendon and extension of infection.

PUNCTURED WOUNDS OF THE SOLE OF THE FOOT

These wounds are usually caused by stepping on a nail, less commonly on stubble, sharp bones, glass splinters, and other soil-contaminated objects.

The pain at the moment of perforation is usually acute, but soon subsides and the lesion may be forgotten. Usually, however, there is moderate inflammatory reaction and after a few hours lameness develops; the foot begins to throb, becomes tender over the plantar surface, and puffy over the dorsum. Usually this wound reaction or mild infection subsides by the third day. How-

ever, extensive cellulitis and tetanus so commonly follow that the prevention of sequelæ becomes the prime consideration in treatment.

The wound is usually contaminated by the perforating instrument, often with soil organisms, such as the tetanus bacillus; the wounds are practically unaërated and are poorly drained because of the contraction of the tough elastic skin and plantar fascia on the tract of perforation.

Treatment.—Usually by rest, hot foot baths, and elevation of the foot for a day the part becomes normal. Such expectant treatment, however, is unwise, since every puncture of the foot must be regarded as the incubus of cellulitis and tetanus. The preferred treatment is as follows:

The patient should receive an immunizing dose of tetanus antitoxin (adult dose 1,500 units), and the wound should be cleansed and drained. As a routine, the superficial wound is enlarged with a fine bistoury under local infiltration anesthesia. The perforation through the plantar fascia may now be detected by a probe, and this layer also is incised. Not infrequently, on probing, a large cleft will be detected where the perforating object has widely torn the loose tissue of the subplantar space. The tract is swabbed with phenol, followed by tincture of iodine. The subplantar space is drained by a few threads of gauze soaked with camphor phenol or mercury ointment passed to the depth of the tract. The drain is cut flush with the skin and the wound covered by a small patch of ointment gauze and adhesive plaster.

When feasible, it is best to rest the foot for a day, soaking it if painful at 3-hour intervals for 15 minutes in a hot foot bath. Usually, however, the patient may be allowed to walk. The drain may be removed after the first day. The operative wound closes with more prompt subsidence of soreness and limp than when the puncture is treated without drainage.

Punctured wounds of the palm should be similarly treated, care being taken to incise no deeper than the palmar fascia, to avoid operative opening of tendon sheaths (see Gunshot Wounds of the Hand).

INFECTIONS OF THE HAND

Introduction.—Infections of the hand are among the most common lesions with which the surgeon must deal. The infection may range from a mild process in the epithelial layers or in the pulp of the finger tip up to a virulent lymphangitis or permanent crippling of the hand by extensive involvement of joints, tendon sheaths, and fascial spaces. These latter infections, particularly of the joints, tendon sheaths, and great spaces of the hand, are for the most part not accurately diagnosed nor intelligently treated even by surgeons of wide experience, largely from lack of general knowledge of the finer anatomy of the hand, of the courses that infection pursues through the tissues, and of the niceties of surgical drainage in this region. The hand must, therefore, be considered in detail apart from the general subject of infection.

This brief consideration of this special subject is based on my experience and that of 20 or more associates, treating many hundreds of the more serious types of these infections at the Roosevelt Hospital, New York. In all save

some minor particulars our experience and technic in infections of the hand run parallel with Kanavel's, as published in his masterly monograph on this subject.

Acute infections of the hand may be divided broadly into: (1) those of the general lymph spaces; (2) those of localized tissue spaces, such as fascial spaces, fat pads, joints, and tendon sheaths. The first group—namely, the lymphangitis group—like follicular tonsillitis, should be viewed as local manifestations of a systemic invasion. This type is best treated by general supportive and local palliative measures, such as the hyperemia induced by heat and by constriction, until such time as the general immunizing force of the body can react. This lymphangitis type of infection is aggravated by incision.

The second group, like suppurative peritonsillar abscess, is to be considered as the local end result of a mild invasion, one in which the systemic fight has been won, but in which the local fight has gone against the individual to the extent of localized cell destruction, characterized by accumulation of pus. In treating these localized infections, the main consideration is to minimize the local destruction and to limit the mechanical spread of infection by prompt and adequate drainage.

The lesions to be first considered are the minor accumulations of pus in the finger tips and small fascial spaces; second, the more serious suppurative infections in the large fascial spaces and in the tendon sheaths and joints; third, acute lymphangitis; and, fourth, miscellaneous and chronic infections.

GENERAL CONSIDERATION OF OPERATIVE INFECTIONS

Anesthetic.—General anesthesia should be induced for the efficient drainage of the more extensive infections of the hand. Local anesthesia should be selected only for the minor infections such as infections of the finger tip and small fascial spaces. The spreading of tissue and the careful blunt dissection and digital exploration necessary in draining the tendon sheaths, the larger joints, and the great fascial spaces of the palm require complete anesthesia and relaxation.

Preparation of the Skin.—Swabbing with tincture of iodine recommends itself for simplicity and efficiency in cleansing the skin.

Hemostasis.—For the more important infections, the field should be rendered bloodless by elastic ligature at the forearm with broad rubber bandage.

Drainage.—Adequate incision should be the chief reliance for drainage. As little foreign drain material should be used as is possible to maintain drainage. In the hand, one must of necessity open through structures which depend for their nourishment largely on diffusion and lymph flow rather than nearby blood supply. It greatly lowers the vitality and power to resist infection, to lay drain material in contact with such poorly nourished structures as tendons, fascia, and joint interiors. The drainage material should be soft and non-irritant. Rubber tubing and other hard material cause various erosive acci-

dents. Dry or moist gauze should never be used as packing except for hemostasis, since it soon clogs up and crusts solid with exudate, acting as a cork, and traumatizes the wound on removal. The best drain is gauze impregnated with ointment; the preferable ointment for acute infections being 10 to 30 per cent. mercurial ointment. Bismuth ointment of 30 per cent. is somewhat less effective in controlling infection, particularly secondary and saprophytic infection. Sterile petrolatum or boric ointment acts well, purely for drainage. Gutta-percha tissue may be used and is excellent as a drain; also strands of silkworm-gut; these latter being particularly useful for drainage of joint cavities, where it is desirable to introduce little bulk of foreign material.

In highly septic wounds, such as tooth wounds, and in wounds with foul discharge, gauze impregnated with camphor-phenol is the preferable material. Camphor-phenol (Chlumsky's solution):

Camphor	60 parts
Phenol	30 parts
Alcohol	10 parts

This combination is anesthetic, antiseptic, stimulating, and non-toxic as a first dressing.

After-treatment.—**REST AND MOTION.**—The part is preferably held elevated and at rest for at least 24 hours. Motion is allowed as soon as there is no discomfort in moving the part, usually after the third day. In fact, it is well to encourage gentle active motion after the third day in operated infections of fascial spaces, joints, and tendon sheaths.

HYPEREMIA.—The artificial induction of hyperemia is a most important measure in the after-treatment of infection. The most desirable form of hyperemia is the active type induced by heat, as by hot baths, baking and sunlight, and other forms of radio-activity. For the first 24 hours the most feasible method is by hot bath, the hand, dressing, and all to be soaked for 15 minutes out of every 3 hours in a bath as hot as the **well** hand can bear, namely, 112° F. Saturated boric acid solution is excellent, since it is nearly isotonic and prevents the growth of saprophytes. Aluminum acetate solution is also good, having the additional advantage of keeping the skin from macerating. Phenol is highly toxic and should not be used. Between soakings the moist dressing may be kept warm by wrapping in a blanket or may be kept cool by open evaporation, whichever is found most comfortable to the patient. After 24 hours the most efficient hyperemia is induced by baking the hand and forearm, dressing removed, for half an hour twice a day, at a temperature around 280° to 350° F. The hyperemia induced by sunlight is also excellent, the hand and forearm being exposed for hours at a time to the direct sunlight.

BIER'S HYPEREMIA.—The constrictive and suction hyperemia of Bier is preferable only when it is desired to prevent an overwhelming absorption of toxins and bacteria into the general circulation after the incision of some highly

virulent process. For this purpose an elastic constricture in the middle of the arm is so applied as to keep the forearm pinkish blue for the first 24 hours. Firmer constriction at the middle of the forearm for half an hour at a time twice a day is useful to flush with exudate ill drained and sluggish wounds. The same effect may be accomplished by the Bier method of suction hyperemia. Sloughs may be thus popped out of suppurating cavities with less trauma than by traction or by pressure.

INFECTIONS OF THE FINGER TIP

Infections of the Epithelial Layers: Abscess Beneath the Stratum Corneum; "Run Around."—Organisms of low virulence, both the streptococcus and staphylococcus aureus, may become implanted beneath the horny layers of the skin, usually by a pin prick. If the infective process remains confined to the stratum mucosum, the horny layers are raised by accumulation of exudate beneath. The infection spreads circumferentially. The exudate in the central area may become inspissated or find exit through rupture of the stratum corneum. If the process passes into the lateral wall of the finger-nail it becomes a chronic, ill drained, obstinate lesion, which may exfoliate the entire nail. The infection causes moderate pain and local swelling and presents a septic blister with reddened margin.

It appears most commonly on the volar aspect of the distal phalanx. Until the horny layer is removed, it cannot be differentiated to a certainty from the small abscesses of the superficial fat pads and sweat glands which point into the same stratum of epithelium, but which present additionally a minute sinus leading to deeper pus pocket—to be considered presently.

TREATMENT.—Abscess of the epithelial layer is readily controlled by free drainage. This is established by peeling the loosened stratum corneum from off the stratum mucosum with thumb forceps. The entire loosened margin is peeled circumferentially well back into the healthy skin, for if any pocket is left the process will extend. A mild antiseptic and protective may now be applied, until the soft layers of epithelium have hardened, such an application as 50 per cent. alcohol or saturated boric acid wet dressing, or weak mercurial, bismuth, or ichthyol ointment.

Abscess of the Nail Sulcus: Paronychia; "Run Around."—An area of soft epithelium is found in the nail sulcus beneath the eponychium. Infection of this area is obstinate because ill drained and is of some importance in that the nail may be exfoliated.

Infections of the nail sulcus may have origin at a distance from the nail as an epidermal abscess. Most commonly the infection arises from a split of the lateral nail wall—a "hangnail," or from misguided trimming of the "cuticle" in manicure procedures.

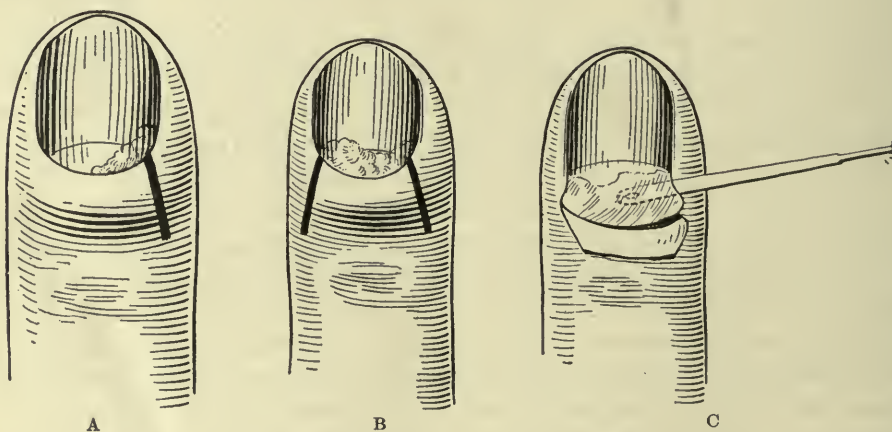
The infection is usually mild, but the course is prolonged because of inadequate drainage. For several days a drop of seropurulent exudate can be pressed from the nail sulcus at one side of the nail. Gradually the process extends

across the nail until the entire proximal sulcus exudes pus. The proximal nail wall is swollen and reddened.

After several days or a week, the infection spreads into the nail bed over the attached germinal border of the nail. A whitened area of purulent exudate soon appears beneath the nail proper and spreads across the entire matrix. If drainage is not established by removal of the loosened nail, suppuration continues and exuberant granulation tissue protrudes from the lateral margin of the nail.

TREATMENT.—BEFORE THE NAIL-BED HAS BECOME INFECTED.—The spread of epidermal infections near the nail should be promptly checked by efficient drainage, as described for abscess beneath the stratum corneum. When the infection has passed beneath the eponychium, this should be torn away and the exudate which has collected in the nail sulcus should be released from beneath the nail wall by loosening the wall from the nail surface with a probe.

If the infection has spread appreciably beneath the eponychium, the wall as a whole should be lifted from the surface of the nail. This is accomplished by an incision under local anesthesia at the infected angle, passing the scalpel back against the nail surface into the sulcus and cutting the wall outward (Fig. 6, A).



OPERATIVE TREATMENT OF ONYCHIA

FIG. 6.—A, Incision of nail wall for drainage of small infection of the nail sulcus. B, Bilateral incision to raise proximal nail wall and drain entire proximal nail sulcus for extensive infection. C, Technic of lifting nail from bed for drainage of infection beneath the nail. Nail is stripped from its bed distally into the uninfected area by a flat instrument and the proximal half of the nail is snipped off.

If the entire proximal sulcus is invaded, the proximal overhanging nail wall should be freed by 2 incisions (Fig. 6, B), so that it can be lifted as a flap and the nail sulcus swabbed with antiseptic such as iodine and packed with mercurial or bismuth ointment gauze. Thus it is possible by efficient drainage of the nail sulcus to forestall invasion of the nail-bed and to save the nail from exfoliation. When the infection is controlled, the flap is allowed to drop into place, where it heals with scarcely perceptible scarring.

AFTER THE NAIL-BED HAS BECOME INFECTED.—When it is evident by a spot of purulent infiltration beneath the nail that the nail matrix is involved, the foregoing drainage is insufficient. The nail itself must be lifted from the infected area. This is done by passing a flat probe under the lateral nail wall, carrying this toward the lateral edge of the horny nail until this can be engaged and lifted by the probe. The entire loosened portion of the nail is now unseated from the nail sulcus. The nail may be more easily unseated and better drainage provided if the nail wall is incised by 1 or 2 incisions (Fig. 6, C), as in the previous infection. It is preferable to unseat not only the loosened portion, but also the entire proximal half of the nail, and to cut it away so that the entire proximal nail sulcus and matrix may be freely drained. Prompt subsidence and restoration of the nail without deformity are thus promoted. Granulations should not be trimmed nor cauterized. These shrink promptly when adequate drainage has been established. Care should be taken not to wound the soft epithelium of the nail matrix or the new nail will be permanently deformed.

The distal uninfected half of the nail may be preserved as a protection to the finger tip and held in place by collodion dressing, until it finally becomes crowded off by the new nail.

For unseating the infected portion of the nail no anesthesia is required, but to incise the nail wall or to strip the entire matrix it is advisable to block the finger tip by local anesthetic.

Abscess of the Finger Pulp.—GENERAL CONSIDERATION.—The finger tip owes its resiliency to multiple locules of adipose tissue encapsulated in dense layers of connective tissue. Near the surface these pads are small; the deeper pads are larger and more densely encapsulated. Sweat-glands are abundant among the superficial pads, and are occasionally found deeply penetrating the dense trabeculae between the larger pads. Suppurative infection may arise in any of these various structures. If infection occurs in a compartment where drainage can be quickly established toward the surface, as in a compartment containing cutaneous glands, the symptoms are relatively slight. But with suppurative infection of the deep fat pads the finger becomes tense and exquisitely tender. The swelling is largely confined to the terminal phalanx. It is important to differentiate suppurative inflammation from lymphangitis, since the former should be treated by incision, whereas the latter is aggravated by incision. Abscess formation or felon differs markedly, both in location of swelling and in extreme tension and tenderness, from simple lymphangitis of the finger tip: in the latter the finger tip is soft, it is only moderately tender, and the swelling is not confined to the terminal phalanx, but spreads up the finger.

ABSCESS OF THE SUPERFICIAL VOLAR FAT PADS AND SWEAT-GLANDS.—Beneath the palmar surface of the finger tip mild infections may arise. The finger becomes moderately tender, tense, and painful. After a day or two a small blister of pus appears beneath the stratum corneum and spreads under this layer. On opening through the horny layer by a knife or needle, the pus

is discharged and the minute perforation is detected through the derma, leading to a small abscess in the pulp.

TREATMENT.—The stratum corneum is first removed from the blister by thumb forceps; then, if the minute drainage tract through the deep layers of the skin appears choked, this is enlarged by a small slit.

ABSCESS OF THE FAT PADS IN THE NAIL WALL LATERAL TO THE NAIL MARGIN.—These parts usually become infected by the staphylococcus aureus finding ingress through a hangnail. The symptoms are much milder than those of infection of the pulp spaces. Usually after 1 sleepless night, a small yellow spot of pus appears beneath the epidermis at the side of the nail.

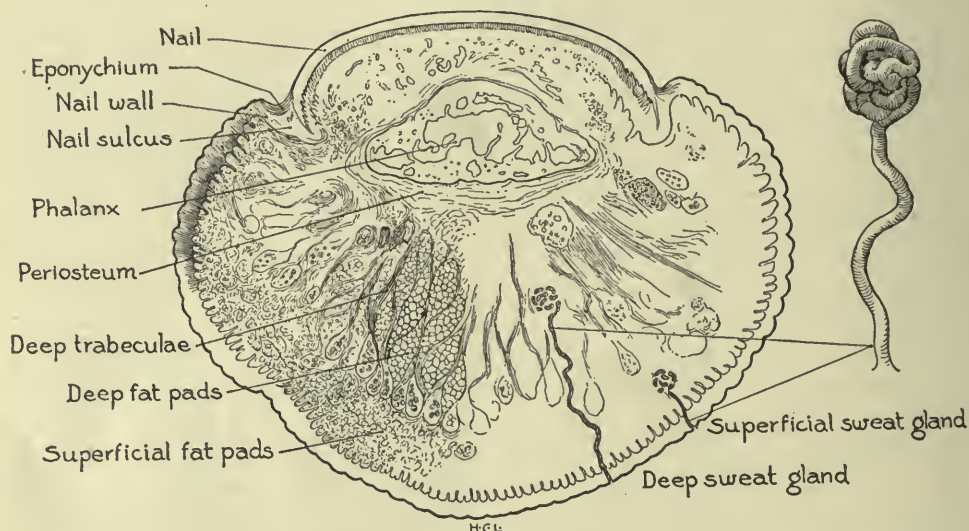


FIG. 7.—SURGICAL ANATOMY, CROSS-SECTION OF FINGER TIP.

TREATMENT.—When the symptoms are mild, the finger may be poulticed with hot boric acid wet dressing or ichthyol ointment until the pus points, when it may be evacuated without pain by teasing through the epidermis with a needle. The wound then heals promptly.

If the pain is considerable or the finger tip becomes tense, then incision is indicated. The area of maximum tenderness is located with the point of a probe, and this area is incised under local anesthesia. When the pus is evacuated, recovery is prompt; if not drained, the pus may spread in the nail sulcus beneath the eponychium and cause infection of the entire sulcus, ultimately becoming subonychia and resulting in exfoliation of the nail.

ABSCESS OF THE DEEP FAT PADS: FELON.—Infection may occur through a small puncture wound or following some trivial contusion of the finger tip. The latter probably affords ingress for bacteria from the deeper sweat-glands (Fig. 7). Occasionally the infection seems to be by the blood stream.

Pus collects under great tension and spreads gradually from one compart-

ment to another or to the bone before it finally finds exit after 4 to 6 days on the surface.

The symptoms are much more marked than in the previous infection. The finger tip is bulbous and indurated, it is exquisitely tender and throbs continually.

TREATMENT.—Incision should be made early. When the finger is of cartilaginous tenseness and exquisitely tender, there is no hope for spontaneous arrest by palliative measures. Delay merely increases the extension of the infection to surrounding pulp and to bone, resulting in sloughing of the pulp, which will require several weeks to be cast off, or in death of the bone. The incision should not be placed on the volar aspect on account of the resultant

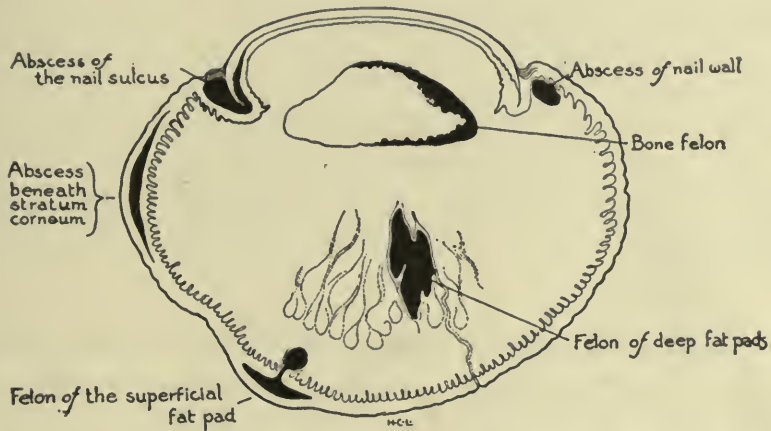


FIG. 8.—POSITION OF PUS IN THE VARIOUS TYPES OF INFECTION IN THE FINGER TIP.

ultimate deformity and painful scar. It should be placed on the lateral border, where the wound drains as well and heals with very little scar. Incision should be made about $\frac{3}{16}$ in. lateral to the margin of the finger-nail, following the minute ridges of the skin to the tip of the finger. If the process is extensive, the incision is continued across the tip down the opposite side of the finger. Thus the palmar pad may be raised as a whole from the periosteum of the phalanx, splitting the finger tip, as it were, in 2 halves.

The wound is packed with gauze impregnated with camphor phenol or with mercurial ointment. After several days, when the acute infection has subsided, packing should be removed. When the sloughs of dense connective tissue have been extruded or absorbed, in the course of several weeks, the skin margins meet and heal with scarcely perceptible scarring.

Osteomyelitis of the Terminal Phalanx: Bone Felon.—The bone may be involved by the extension of the infection from a deep fat pad, or it may be primarily the seat of a suppurative periostitis, the organism finding ingress through a minute wound or less commonly by the blood stream. The symptoms are similar to those of a fat pad felon, but of greater severity. The distal $\frac{3}{4}$

or diaphysis of the phalanx is affected. That segment entering into the joint and receiving the implantation of dorsal and flexor tendon, namely, the epiphysis, is rarely involved.

TREATMENT.—The finger tip should be split widely open into anteroposterior halves, and the denuded bone packed off until the acute symptoms have subsided. The same incision should be used as for extensive fat pad felon, following the normal markings of the skin parallel to the borders of the nail across the tip of the finger. When the extreme pain and swelling have subsided, after several days, the soft parts should be allowed to drop against the bone. If only a thin scale of bone has been killed, this may be absorbed and the wound healed within several weeks. On the other hand, if the entire diaphysis has been denuded, this will become a sequestrum. After the acute symptoms have subsided, the terminal denuded half or more may be cut away by stout seissors. Traction should not be used to separate the distal necrotic diaphysis from the proximally placed unaffected epiphysis, since the phalangeal joint or flexor tendon sheath may be torn open to secondary infection. The best end result is secured by patiently awaiting spontaneous separation, complete in 4 to 6 weeks. Bone should be cut away at the time of the original operation only when the finger pulp is a necrotic mass and the diaphysis of the phalanx is beyond doubt dead in its entirety.

CELLULITIS AND ABSCESS FORMATION IN THE MINOR SPACES

Cellular Spaces of the Proximal and Second Phalanges.—Infection usually arises from incised wounds of the volar surface and abrasions of the dorsal surface. The cellulitis spreads rapidly to the side of the finger, then into the web, where considerable accumulation of pus is common. The tendon sheaths and joints are rarely invaded secondarily unless opened by the wound.

TREATMENT.—In plotting the incision, no reliance is to be placed on the location of maximum redness and swelling, these signs being most intense in the loose uninfected tissue of the dorsum of the fingers. The site of incision is governed by the point of greatest tenderness. Incision is preferably placed at the side of the finger. Care is taken not to wound the flexor sheaths.

The Web Spaces Between the Fingers.—A loose areolar tissue space exists in the web of the fingers bounded dorsally by the skin and on the palmar side by attenuated palmar fascia. Into this space exudate collects from infection of the fingers. A common abscess, the "collar-button abscess," arises from infection of fissures and abrasions in the palm; the pus collecting beneath the tough palmar skin points backward, often through a deficiency in the palmar fascia. Thus a collar-button shaped abscess may be formed, the head beneath the palmar skin, the neck at the palmar fascia and the base in the web space.

The web space also receives the purulent exudate from abscess of the great palmar spaces, draining distally along the lumbrical muscles. Pus also col-

lects from rupture of an infected metacarpophalangeal joint and from the flexor tendon sheath.

TREATMENT.—It must be borne in mind that mere puffing of the web space does not signify pus, and that ill-timed incision may add to the virulency of a simple lymphangitis.

When tense distention and marked local tenderness indicate the presence of pus in the web space, drainage should be promptly instituted. A dorsal incision about $\frac{1}{2}$ in. long is placed between the knuckles beginning $\frac{1}{2}$ in. proximal to the web. The space is explored by an artery clamp. If the instrument leads through the palmar fascia, a second small incision is made over the end of the artery clamp in the palm, and a small wick of ointment gauze is drawn through the web.

Extensions into or from the thenar and mid-palmar space and into the dorsal subcutaneous tissue are drained as described under these lesions.

Minor Spaces of the Web of the Thumb.—Loose pockets exist in the web of the thumb, more clearly bursal in character than the loose tissue of the foregoing webs. Localized infection is treated by incision and drainage, avoiding if possible the great thenar space.

The Hypothenar Space.—Between the bellies of the short muscle of the little finger and the fifth metacarpal bone, there are a number of loose planes of tissue. Into this hypothenar tissue bacteria may be implanted and pus collect, usually from wounds and abrasions of the ulnar border of the hand. These infections are relatively rare and unimportant. The pus remains localized in the hypothenar area and points ultimately toward the ulnar border of the hand. The general area involved and the line of incision, parallel to the fifth metacarpal bone, are indicated in Figure 9. Insertion of drainage material is scarcely necessary.

A group of infections far more serious in general intoxication, and locally of much graver consequence in permanently crippling the hand, is now to be considered.

CELLULITIS AND ABSCESS FORMATION IN THE MAJOR SPACES

The Great Palmar Spaces.—Beneath the palmar fascia there are found 2 great bursal spaces which allow the palmar fascia and flexor tendons to move freely upon the metacarpal bones and short muscles of the fingers. One space to the thumb side is called the thenar space, the other, the mid-palmar space (Fig. 9).

THE THENAR SPACE.—If one grasps, between the thumb and forefinger, the belly of the adductor pollicis in the space between the first and second metacarpal bones, the finger sinks into a space between this muscle dorsally and the palmar fascia anteriorly. On moving the index finger, the flexor tendon can be felt to slide where it lies against the palmar fascia anterior to this space.

The space continues inward beneath the palmar fascia between this and the second metacarpal bone to the middle finger. It is here cut off from the main palmar space by fibrous tissue. The space extends dorsally in a small, deep reflection across the free border of the adductor transversus between this muscle and the first dorsal interosseous muscle (Fig. 9).

Infection of this space may rise from puncture wounds of the radial half of

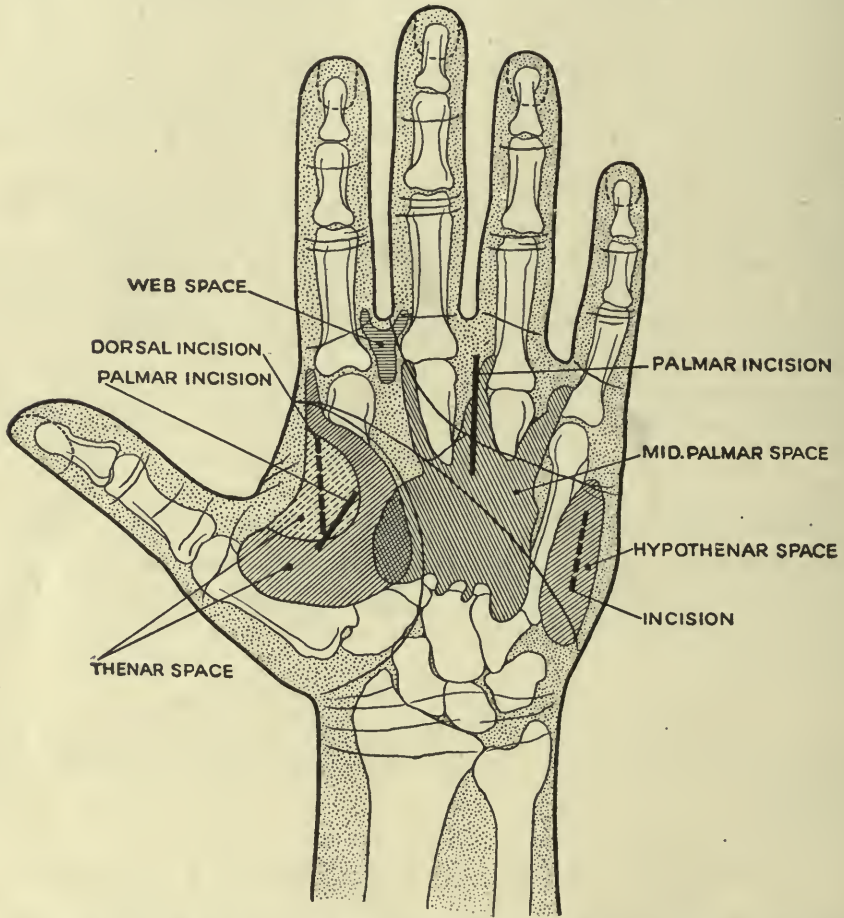


FIG. 9.—OUTLINES OF THE PALMAR SPACES AND THE PREFERRED SITE OF INCISION FOR THEIR RESPECTIVE DRAINAGE.

the palm, also from puncture wounds posteriorly between the first and second metacarpal bones. More commonly the space is infected by the extension of cellulitis from the outer side of the index finger and the inner side of the thumb, also from the bursting of tendon sheath infections involving the flexor sheath of the thumb and that of the index finger. The space may also be infected by absorption from abrasions and superficial wounds of this region and by extension from the mid-palmar space.

DIAGNOSIS.—The condition is to be differentiated from small subcutaneous abscesses and infection of minor spaces such as follow superficial abrasions and small puncture wounds of the web of the thumb. Infection of the large thenar space is accompanied by more extensive tenderness and more brawny ballooning of the web than characterizes localized abscess.

TREATMENT.—The space is opened and drained, preferably through a dorsal incision about $\frac{3}{4}$ in. long parallel to the axis of the index finger and to the

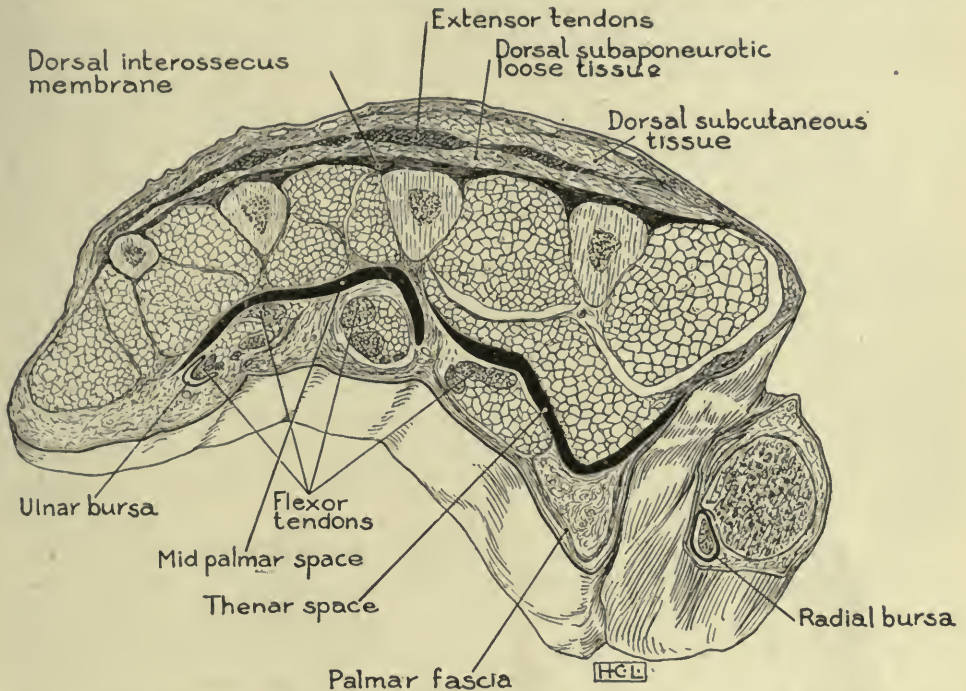


FIG. 10.—TRANSVERSE SECTION THROUGH MIDDLE THIRD OF PALM OF HAND. This shows the cellular and bursal spaces in which pus collects, showing, first, the loose dorsal subcutaneous tissue separated from, second, the subaponeurotic space by tendons and eponeurosis and underlain by the dense dorsal interosseous membrane. Third, the mid-palmar and thenar spaces are indicated bounded on the dorsum by the osseous and muscle body of the hand and on the palmar side by the palmar fascia by flexor tendons and sheaths and important vascular and nerve trunks. (After Kanavel.)

thumb side of the bellies of the interossei muscles of the finger. A blunt instrument or a finger is passed gently to the depth of the thenar space between the palmar fascia and the index metacarpal. If the instrument is felt superficially in the palm, a counter incision is made in the web parallel to the adductor crease of the thumb. The wound is packed with ointment gauze sufficient to control venous oozing. This is removed after 3 days, when the acute symptoms have subsided.

THE MID-PALMAR SPACE.—A large and important cellular and bursal space is found beneath the palmar fascia at the middle of the palm. This space is traversed on the palmar side by the flexor tendons of the third, fourth, and fifth fingers in intimate relation with the palmar fascia. Adjacent to the

space are the proximal ends of the flexor sheaths of the third and fourth finger, and the distal ends of the ulnar bursa. It is limited dorsally by the metacarpal bones and the interosseous muscles and membranes, on the ulnar side by the short muscles of the little finger, and on the radial side by fibrous tissue separating it at the middle metacarpal bone from the thenar space. It usually overlaps and occasionally communicates with the thenar space at the proximal end. It also communicates freely with the 3 web spaces between the fingers, by a loose areolar tissue channel around the lumbrical muscles.

The mid-palmar space is infected by puncture wounds in the middle of the palm. It becomes infected secondary to infections in the web, usually between the second and third, and the third and fourth fingers, also from rupture of the tendon sheaths of the third, fourth, and fifth fingers and of the ulnar bursa. It may be invaded by extension from the thenar space or from osteomyelitis or septic arthritis of neighboring bones and joints. Infection of this space endangers the entire group of flexor tendons, and unless prompt, efficient drainage is established, total crippling of the hand may be the local outcome. With efficient drainage, perfect function may be preserved. When the lesion points spontaneously, this usually occurs along the lumbrical canals into the web spaces of the fingers. Occasionally the overlying fascia and skin are eroded. Rarely can the pus force its way into the dorsal subaponeurotic space, although the intense lymph drainage toward the dorsum, with resultant swelling on the back of the hand, gives rise to the false impression that the pus has pointed through the body of the hand.

TREATMENT.—Incision is placed, preferably, starting between the callosities of the third and fourth fingers and continued 1 in. vertically into the palm to the level of the main transverse flexion crease. If either of the other 2 interdigital spaces seem to be involved, these are selected as a site for similar incision. The incision is continued through the palmar fascia until the lumbrical space is reached. Up through this space a blunt instrument, such as an artery clamp, is passed into the main palmar space, beneath the flexor tendons. The loose tissue of the palmar space is gently explored and free drainage established. A drain of gutta percha or ointment gauze may be inserted and left in situ for several days. If the dorsal subaponeurotic space is also involved, as, for example, in compound fractures of the metacarpal bone, then through-and-through drainage is instituted, crowding with an artery clamp between the metacarpal bones and out through the dorsum between the extensor tendons.

If the thenar space is involved as well, the artery clamp is passed across beneath the flexor tendons, and out through the thenar drainage incision, and a wick of ointment gauze is drawn through as a drain.

Dorsal Subcutaneous Spaces.—The skin over the dorsum of the hand slides freely upon the tendons and the aponeurosis beneath, because of the loose mesh of tissue between. This loose tissue frequently becomes the seat of cellulitis and purulent collection. Cellulitis is occasioned by abrasions, burns, and other

wounds of the dorsum of the hand. The spaces are also invaded by direct extension from the fingers and web spaces.

Cellulitis must be differentiated from lymphedema of this space. In all infections of the hand the lymphatics course backward and fluid collects in abundance in the web spaces and dorsal subcutaneous space. In this non-suppurative lymphatic edema, the skin may become hot, reddened, and puffy, but the dorsum of the hand does not present the extreme ballooning, induration, and tenderness which characterize pus accumulation. For lymphedema, the dorsum of the hand should not be incised. For pus collection it should be drained promptly.

TREATMENT.—Usually 1 or more of the web spaces are also infected, and these are best drained by a small dorsal incision between the knuckles. An artery clamp or finger may be passed into this wound and swept beneath the skin. It will dissect its way easily into the diseased tissue; thus the various pockets are broken up. One or more longitudinal counter openings are placed at the extremes of the dissected area. As a drain, a small fold of gutta percha tissue or ointment gauze may be passed from one opening to another.

The Dorsal Subaponeurotic Space.—Under the extensor tendons from the knuckles to the wrist there is found a series of spaces in the loose arcolar tissue similar to the subcutaneous spaces. Overlying this space is a broad aponeurosis connecting the extensor tendons, so that pus in this layer is confined between the aponeurosis and the dorsal interosseous membrane and must point laterally at the borders of the hand or distally into the web spaces.

This space most commonly becomes infected through crushing injuries of the hand, also by wounds of the dorsum of the hand and by extension from osteomyelitis of the metacarpal bones. Occasionally pus from the palm may point through the body of the hand. Most commonly, however, pus alleged to have accumulated in this area is obtained from the great palmar bursa by misguided drainage incision and deep exploration over the dorsum of the hand.

TREATMENT.—When it is decided, because of deep tenderness and extreme induration over the dorsum of the hand, that the subaponeurotic layer is the seat of infection, it should be drained as follows:

From the level of the knuckles an incision 1 in. long is carried proximally between the extensor tendon of the middle finger and that of the ring or the index finger. The aponeurosis is incised and the subaponeurotic space swept with an artery clamp for purulent collection. If pus pockets are found, the space may be loosely packed with ointment gauze for several days. Usually no counter incision is demanded.

ACUTE SUPPURATIVE TENOSYNOVITIS

GENERAL CONSIDERATIONS

Etiology.—The most common cause of virulent infections of the tendon sheaths is a minute puncture wound such as a needle or thorn prick. The or-

ganism which finds ingress through such puncture wounds is usually the streptococcus.

Infection also gains access through lacerated and incised wounds and by extension from cellulitis of subcutaneous tissue. These infections, because of drainage, are usually less rapid in spread. Occasionally they remain restricted by plastic exudate to a portion of the sheath only. These open wound infections are not infrequently caused by the staphylococcus aureus or by mixed bacteria.

Diagnosis.—The symptoms of tendon sheath infection vary only in degree from those of other infections of the hand. The symptoms are not obvious, hence the points of differentiation must be known and intelligently elicited. The most important sign is that of exquisite deep tenderness over the course of the sheath, sharply limited to the sheath. In addition to this sign, one must consider the history, the attitude of the finger, and the character of the loss of function. The characteristic history is that 1 or 2 days after a trivial injury, such as a needle prick over the volar aspect of the finger, the finger begins to throb and ache and becomes stiffened and slightly swollen. On inspection, it is noted, early in the inflammation, that there is very little reddening of the finger, that the finger is only moderately swollen, and that swelling is most marked over the dorsum. There is local heat. The finger is held stiffly in semiflexion. It can be flexed further, but both active and passive attempts to straighten the finger cause pain and resistance. At a more advanced stage of the infection, particularly with rupture of the tendon sheath, the reddening and swelling increase, but the pain and functional disability become less marked due to relief from tension and analgesia from tissue edema and necrosis. Mistake in diagnosis arises largely from the slight superficial evidence of serious infection.

As already stated, the most reliable symptom is that of localized tenderness. Tenderness is elicited by placing the affected hand at rest, palm upward, and then pressing deeply, first at a distance from the infected area. The patient will volunteer that the point pressed upon is tender, but he does not wince nor withdraw the hand. Gentle but increasingly forceful deep pressure is then made over the sheath. Suddenly the pressure causes agonizing pain, and the patient winces and draws the hand away. This deep tenderness is most pronounced and characteristic at the proximal end of the flexor sheath. After the sheath has ruptured, there may be very little tenderness over the distal portion of the sheath. In weighing symptoms, it is usually a decisive indication for operation on the first, second, or third fingers that deep tenderness exists above the head of the metacarpal bone in the palm, coupled with the finding that such exquisite tenderness does not exist half an inch proximal to that point. In the case of the thumb and little finger, a similarly decisive point is determined 1 in. above the wrist joint, over the proximal ends of the radial and ulnar bursa respectively.

Course.—When incised and drained early—that is, within 24 hours from the onset of marked symptoms—the infection usually subsides, the sheath

ceases to exude after about 5 days and the wound heals completely within 2 weeks. The function of the finger may become fully restored within 6 weeks; usually, however, slight flexion contracture of the scars is noticeable. With certain virulent infections or infections mistreated by extensive incision and over-zealous after-treatment, as in packing, washing, and prodding, such favorable results are not secured.

When opened early, the sheath is slightly reddened and edematous, and contains slightly turbid synovial fluid and a tendon that is white and lustrous. When, however, incision has been delayed 3 days or more, it is usual to find pus outside the sheath, a friable edematous opaque sheath, purulent synovial fluid within the sheath, and the tendon grayish and without luster. In this event, particularly if the tendon is distinctly grayish and edematous, it sloughs; the wound discharge gradually increases; and after 10 days a soft yellow slough protrudes from the sinuses and gradually the swollen tendon presents. In 3 to 4 weeks the tendon is cast out en masse as a yellow slough.

INCISION.—Tendon sheaths should be opened by multiple small incisions. The most important incision is the one which completely opens any proximal pocket. Extensive incision is unnecessary for complete drainage and is, in fact, vicious in that it releases the tendon from its bed, destroys the bursa, and usually results in devitalization and ultimate sloughing of the tendon.

Drainage.—In establishing drainage, no foreign material should be introduced within the sheath and no wash should be used. Inflammatory exudate is the best cleansing wash. It suffices to drain the exudate away from the sheath by ointment gauze packing or other non-clogging drain material which holds open the soft parts to the mouth of the incision into the sheath.

CONSIDERATION OF SPECIAL SHEATHS

Sheaths of the Flexor Tendons to the First, Second, and Third Fingers.—These sheaths, particularly of the middle and index fingers, are the most exposed to penetrating injury in grasping sharp objects. Fortunately infection in these sheaths is not as serious as in the more extensive sheaths of the little finger and the thumb.

SURGICAL ANATOMY.—The flexor tendons of the first 3 fingers are invested by synovial sheath from a point proximal to the head of the respective metacarpal bone distally to the insertion of the profundus tendon into the last phalanx. The proximal limit of these sheaths is roughly indicated, in superficial marking, by the great transverse flexion crease of the palm. These sheaths occasionally communicate with the proximal interphalangeal joint; thus this joint may become infected from the sheath or the reverse. At the proximal end the sheath is lax and presents 2 lateral pockets. Pus accumulating in the sheath usually bursts through at this place and points into the web space. Another and more serious route which the pus may take is into the great thenar space

from the index finger or into the middle palmar space from the middle or ring finger. Again pus may point to the surface through the palmar fascia.

DIAGNOSIS.—As set forth previously, the most important point in early diagnosis is exquisite tenderness localized to the sheath, particularly acute at the proximal end.

TREATMENT.—The treatment consists in immediate incision and drainage.

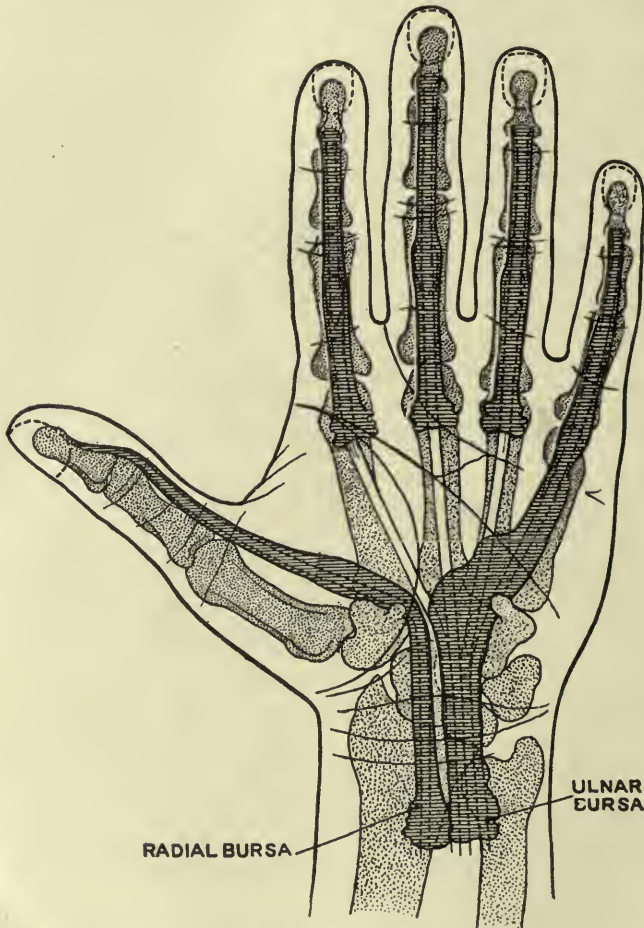


FIG. 11.—FLEXOR TENDON SHEATHS. Usual arrangement and relationship to the superficial markings and osseous structure.

When in doubt, incise. In following the after-results of various incorrectly diagnosed and mishandled lesions, I have never seen harm come from exploratory incision, while disaster to the hand has repeatedly followed misjudgment in adopting palliative measures. With some experience in eliciting local tenderness, the mistakes in diagnosis should become rare.

The first incision is made into that portion of the sheath furthest removed from the original site of infection, in other words, in that section most free

from mixed bacteria. The first incision opens through the callosity at the base of the finger and continues toward the transverse flexion crease a distance of $\frac{1}{2}$ in. The tissue is retracted strongly, the tendon is felt to move on passive motion, and the sheath is opened to the extent of $\frac{1}{4}$ in. Blunt seissors are engaged in the opening, and the sheath is opened to its proximal limit and snipped free from the tendon laterally, opening the side pockets. It is in these lateral pockets that the bulk of turbid synovial fluid will be found, possibly 3 drops or more.

The second incision is placed vertical to one side of the median line between the flexion creases over the first phalanx (Fig. 12). The third incision is similarly placed to the opposite side of the median line over the second phalanx, and the tendon sheath opened for about $\frac{1}{4}$ in. A bridge of normal skin is left at the flexion creases to avoid ultimate flexion contracture. The cutaneous wounds are packed open with ointment or camphor-phenol gauze drains. The after-treatment is outlined under the general consideration of operative infections of the hand.

To avoid the oft-time centrally placed incision and scar contracture, Bier has adopted a bilateral incision (Fig. 12). The volar pad as a whole may be raised after opening the tendon sheath, by a through strip of packing. I have found no advantage in this incision.

When the sheath is opened early, the end-results are excellent, the sheath usually being closed by the eighth day and the wounds scabbed by the fourteenth day.

If the tendon has been long bathed in pus and is gray and lusterless when first inspected, or if it is traumatized by the exposure of long incisions and by rough manipulation and antiseptic irrigation, the tendon usually dies. In this event it gradually presents as a slough through the several openings and becomes separated and extruded in about 3 or 4 weeks. Spontaneous separation of the slough should be awaited patiently and no additional trauma done by pulling or trimming.

Tendon Sheath of the Little Finger and the Ulnar Bursa.—SURGICAL ANATOMY. —The flexor tendons of the little finger are invested as are the 3 other fingers, except that the sheath, in $\frac{2}{3}$ or more of all cases, does not terminate proximal to the head of the fifth metacarpal bone but becomes continuous with the ulnar bursa. An attempt at closure at this point is marked by constriction. The sheath continues on a line drawn from the head of the fifth metacarpal to the radial styloid. In the proximal third of the palm it envelops the tendons of the other 3 fingers and continues beneath the annular ligaments into the forearm to a level 1 in. proximal to the wrist joint. This expansion and extensive investinent is known as the ulnar bursa. The sac does not completely surround the tendons in a tubular manner, but sends, from a common pocket on the ulnar side, first, a short superficial fold across the sublimis tendons of the ring and little fingers; second, a middle fold between the sublimis and profundus tendons; and third, a deep fold beneath the entire flexor group. The radial por-

tion of the middle and deep folds investing the tendons of the index and middle fingers often exist as separate bursal sacs. This is of no surgical importance, since if they are absolutely separated they rarely become infected. The deep or the median fold communicates anatomically with the radial bursa in 50 per cent. of all cases. It is found clinically that infections of either

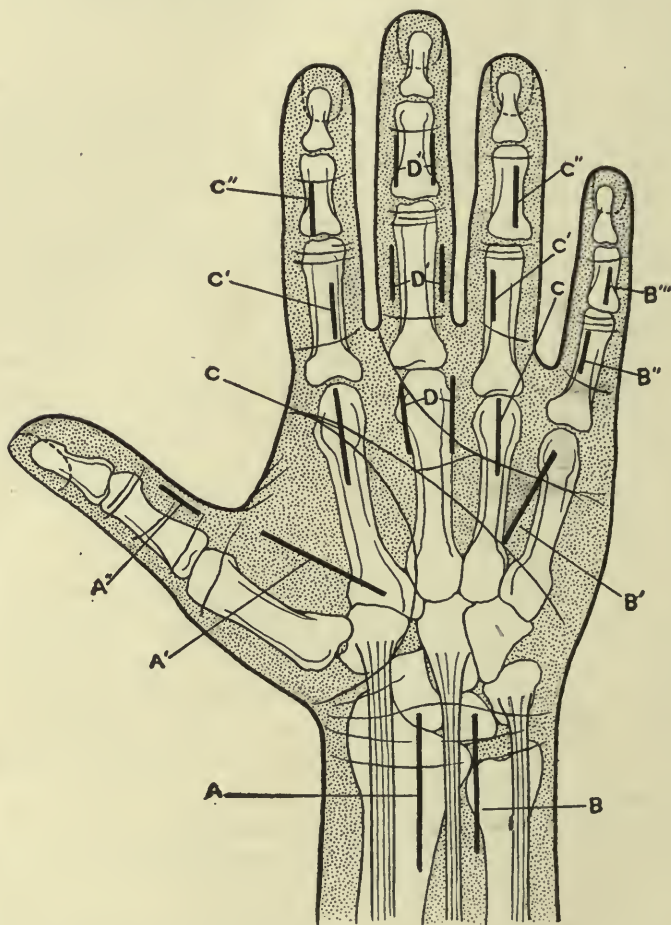


FIG. 12.—PLAN OF INCISIONS FOR DRAINAGE OF FLEXOR TENDON SHEATHS. A A' A'', incisions for drainage of the radial bursa and the thumb sheath; B B' B'' B''', incisions for drainage of the ulnar bursa and the sheath of the little finger; C C' C'', incisions for drainage of the flexor sheath of any of the three middle fingers; D D' D'', bilateral incisions for drainage. (Bier type.) Figure shows additionally relationship of these incisions to the flexion creases or surface markings of the hand and also to the underlying osseous structure.

bursa of any considerable virulency, or undrained and of several days' standing, in practically all cases infect the opposing bursa.

DIAGNOSIS.—Early in the infection the superficial signs are slight. The small finger, the palm, and the wrist are slightly swollen. There are moderate heat and slight reddening, most perceptibly above the flexion crease of the wrist

The loose tissue above the annular ligaments becomes considerably swollen in the course of 24 hours. The little finger is held stiffly against full extension.

The most important symptom is the deep tenderness over the length of the sheath, particularly acute to the radial side of the head of the fifth metacarpal bone, also acute and most characteristic to the ulnar side of the palmaris longus, $\frac{3}{4}$ in. above the wrist.

TREATMENT.—The first incision begins at the flexor crease of the wrist and is carried 1 in. proximally, parallel to and to the radial side of the flexor carpi ulnaris. The common flexor sheath or ulnar bursa is opened along the ulnar side of the common pocket, so as to drain all 3 pouches. It is slit to its proximal limit or for about $\frac{3}{4}$ in. The second incision is an oblique incision in the palm an inch long, beginning to the radial side of the head of the fifth metacarpal bone. The tendon sheath is opened so that drainage is free both on the proximal and distal side of the constriction which normally occurs at this point. The opening in the sheath is enlarged by slitting proximally with scissors up to the proximal fourth of the palm. The ulnar bursa is usually not opened to its entire length, as it is found clinically that free drainage of the upper and lower pockets yields as good drainage and better end-results than do long and deforming incisions. The third and fourth incisions are placed over the first and second phalanges respectively, as in the other fingers.

Tendon Sheaths of the Thumb and Radial Bursa.—The sheath of the flexor longus pollicis is rarely closed off below the head of the first metacarpal bone as are the sheaths of the neighboring fingers. It continues to invest the tendon completely as it courses obliquely across the radial half of the palm. At the trapezium, directly beneath the adductor crease of the thumb, the tendon turns vertically into the wrist. The sheath follows the tendon to a level 1 in. above the wrist joint, being known as the radial bursa. This sheath is most commonly infected through an incised wound over the first phalanx of the thumb and by extension from the ulnar bursa. The symptoms are similar to infection of the small finger. The swelling in the wrist is more prominent to the radial side. The diagnostic points of tenderness are: First, a point just distal to the fleshy mass of the thenar eminence in line with the index finger; second, a point $\frac{3}{4}$ in. above the flexor crease of the wrist to the radial side of the palmaris longus tendon.

TREATMENT.—The incision is placed between the palmaris longus and the flexor carpi radialis (Fig. 12). It begins at the flexor crease and extends proximally for 1 in. The tissues are retracted and the thumb tendon is felt to move beneath the palpating finger. The sheath is opened and split to its proximal limit. The second incision is placed obliquely—almost transversely—distal to the thenar eminence at the junction of the proximal and the middle thirds of the palm. The tissue is retracted and the tendon felt to move beneath the muscle bellies, which make up the thenar eminence. These muscles are split in the direction of their fibers, and the sheath is opened from the head of the

first metacarpal bone to where it bends around the trapezium. The third incision is placed over the first phalanx.

Tendon Sheaths of the Dorsum.—The various extensor sheaths rarely become infected except by incised wounds over the back of the wrist. Anatomically (Fig. 13) they extend from the middle of the metacarpal bones to 1 in. above the wrist. They do not intercommunicate, and infection is neither so severe nor the symptoms so marked, nor are the after-results so crippling as with infec-

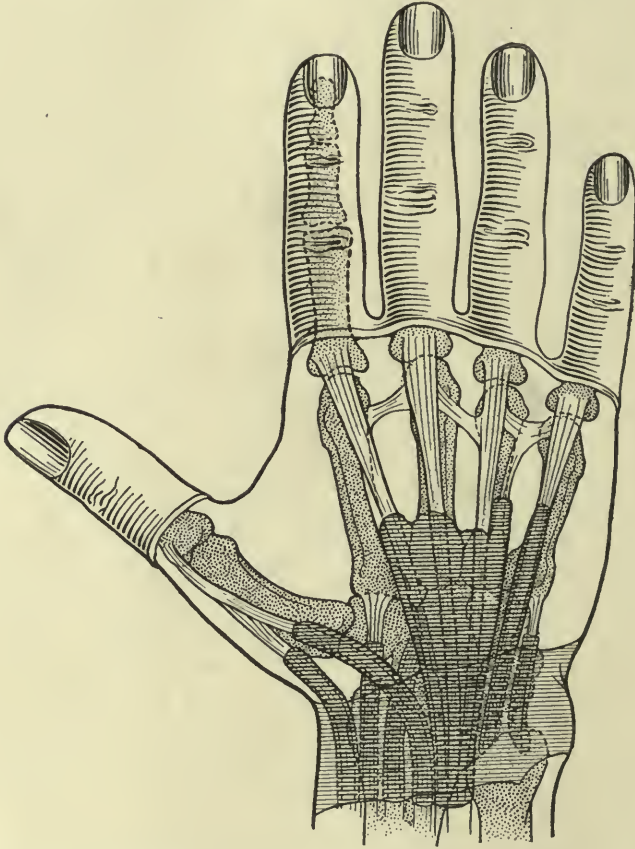


FIG. 13.—DORSAL TENDON SHEATHS. Indicated by dark shading. Incision for drainage should be placed at the distal and proximal extremities of the sheath infected, namely, an incision one-half an inch long over the base of the metatarsal bone, and a second incision one-half an inch long proximal to the wrist joint.

tion of the flexor tendons. The condition may be differentiated from cellulitis of the dorsal subcutaneous tissue by the localization of the tenderness.

TREATMENT.—When infected, those compartments of the dorsal sheaths which are tender are opened by 2 small incisions, one over the base of the metacarpals and the other above the wrist, opening the proximal and distal extremities of each infected sheath. Packing and after-treatment are on the general lines laid down for the flexor tendons.

EXTENSION INTO THE FOREARM FROM INFECTIONS OF THE HAND

Superficial abscess and extensive subcutaneous cellulitis may arise anywhere in the forearm from lymphatic infection along the course of the lymph-vessels draining the various septic lesions of the hand. However, the most common and serious lesion is a direct extension into the forearm of a purulent process traveling beneath the flexor group of muscles. The process may follow

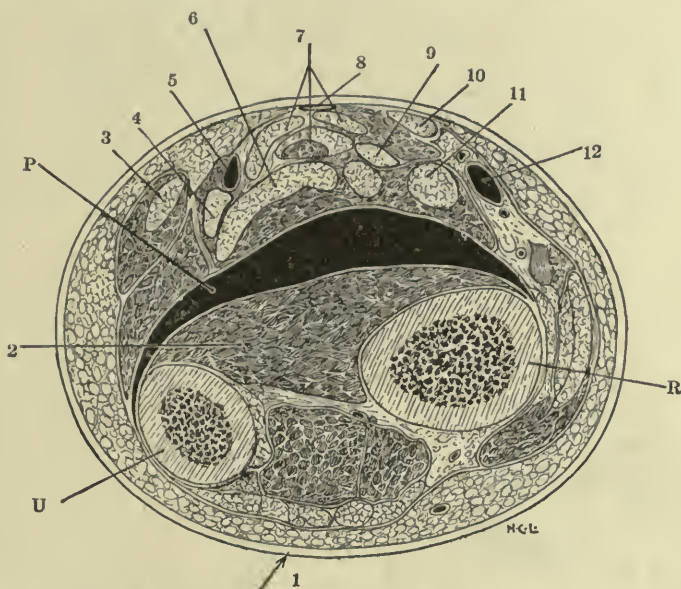


FIG. 14.—CROSS-SECTION OF WRIST TWO INCHES ABOVE STYLOID PROCESS OF RADIUS. R, Radius; U, ulna; P, space usually dissected by pus extending from the radial and ulnar bursa into the forearm. 1, Dorsal muscles; 2, pronator quadratus; 3, flexor carpi ulnaris; 4, ulnar nerve; 5, ulnar vessels; 6, flexor profundus digitorum; 7, flexor sublimis digitorum; 8, palmaris longus; 9, median nerve; 10, flexor carpi radialis; 11, flexor longus pollicis; 12, radial artery. (After Kanavel.)

an extension beneath the annular ligament from a mid-palmar infection. More commonly it follows rupture of septic infection from the radial or the ulnar bursa. The forearm becomes edematous and tender. General intoxication may be severe. The plane of tissue dissected by the pus is indicated at successive levels in Figures 14 and 15.

Treatment.—When only the distal half of the forearm is involved, the incision for the most efficient drainage is placed at the volar border of the ulna between this bone and the flexor muscles. The incision is about 2 in. long and opens the space between the flexor muscles and the various vascular and nerve trunks anteriorly, and the bones and interosseous membrane posteriorly. If the process is extensive, an artery clamp is passed across the surface of the radius and a 2-in. counter incision is made along the radial border. A finger is now swept in the space. If the exploring finger can sweep freely up the forearm and the tissue separates easily with a soft crackle, then the infection has spread beyond the control of this distal drainage. A second drainage level is estab-

lished just above the middle of the forearm by placing a 2-in. incision at the ulnar border of those muscles which arise from the inner epicondyle of the humerus. The fingers separates these muscles, principally the *sublimis digitorum*, from the *flexor carpi ulnaris*. A loose space is now broken into, which

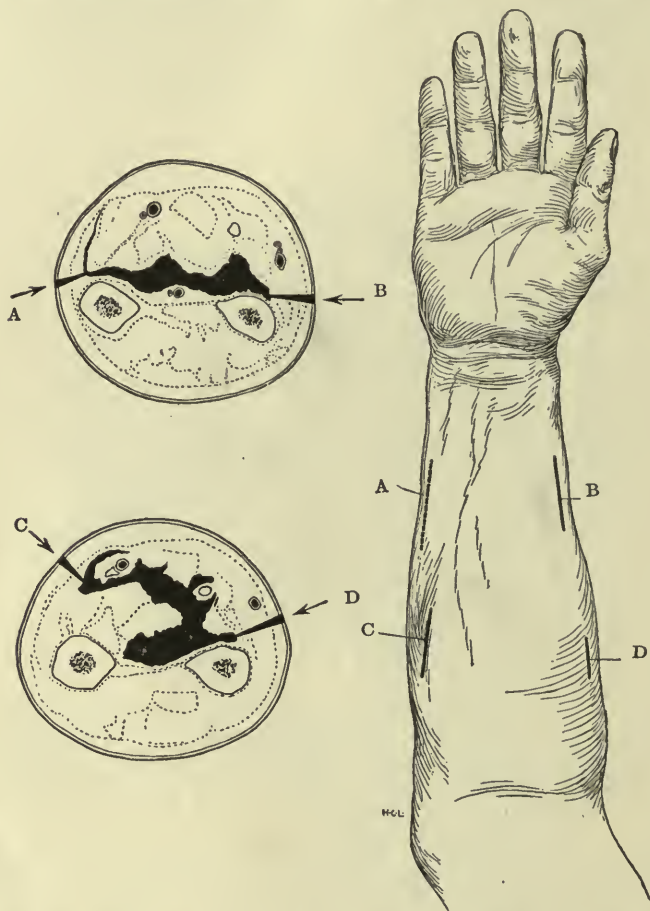


FIG. 15.—INCISION FOR DRAINAGE OF DEEP CELLULITIS OF FOREARM. A, Incision at the border of the ulna; B, counter incision on instrument passed beneath the entire flexor group of muscles; C, incision for drainage at higher level at inner border of fleshy bellies which arises from the internal condyle; D, counter incision at the inner border of supinator longus. The cross-sections (after Kanavel) show the usual dissection by pus at levels A, B, and C, D, and indicate the site of drainage incisions.

should be swept by the finger. A small counter incision is placed to the radial side of the supinator longus. Through-and-through drainage may be established for a few days by wicks of ointment gauze.

SEPTIC ARTHRITIS

Distal Interphalangeal Joint.—This joint usually becomes infected by a compound opening, as in a crushing injury. The joint continues to suppurate for

about 4 or 5 weeks, discharging through the original wound or through new sinuses. After the cartilage has flaked off, healing takes place by fibrous union between the 2 phalanges.

Proximal Phalangeal Joint.—This joint is usually infected by punctured and incised wounds over the dorsum. The anterior ligament between the joint and the flexor tendon sheath is very thin and occasionally patent. Therefore, extension of infection from joint to flexor sheath, or vice versa, is common. Associated with infections of this joint, it is common to have an osteomyelitis of the proximal end of the middle phalanx. After a week or so of suppurative inflammation, the joint discharges through 1 or more pouting sinuses. These sinuses tend to close and re-open. When the cartilage of the middle phalanx has sealed off, the joint usually heals after 4 to 6 weeks of suppuration. The joint becomes stiffened by fibrous union in a position of semiflexion. If the middle phalanx becomes necrotic, sequestrum formation may require 8 weeks or more.

TREATMENT.—Drainage should be instituted promptly to avoid extension to the tendon sheath and bone. Lateral incisions should be made over the joint, and both lateral ligaments severed. A few strands of silkworm-gut may be drawn through the joint until the acute symptoms have subsided. If the patient is a laborer, who will be crippled by a stiff joint or who is unable to nurse a disabled finger for 4 weeks or more, then it is best to amputate the finger, particularly if the flexor tendon sheath is involved. Otherwise, the best cosmetic results are obtained by patiently waiting for suppuration to cease and for sequestrum to loosen.

Metacarpophalangeal Joint.—This joint is usually infected by a wound received across the knuckles with the fist clenched. The most common wound in an American city is sustained by punching an opponent in the teeth with the clenched fist. As a rule, wounds over the bared knuckle penetrate the joint. Two or 3 days after the wound has been received, the finger becomes stiff, the web space edematous, and, with tooth wounds, the original wound foully infected. The joint is tender to deep pressure in the palm, and turbid synovial fluid can often be expressed from the dorsal wound. Tooth wounds sustained in striking a blow should be regarded as a rule as penetrating injuries and as violently infected.

TREATMENT.—The fresh wound should be carbolized and iodized and opened for wider drainage by a longitudinal incision. If any wound of the extensor tendon can be detected, or if the tissue to either side is torn, the injury should be regarded as having penetrated the joint. Owing to many planes of sliding tissue, it is not always possible to demonstrate this perforation. However, as a rule, if the joint remains unopened, within 3 days symptoms of septic arthritis will have developed. It is best to open the joint immediately and to wash and drain it. By this routine treatment a large proportion of the invaded joints are saved from suppuration.

Drainage into the joint should not be made through the original wound, as

this wound usually becomes foul and sloughy. Drainage should be established by 2 vertical incisions in the web, 1 on each side of the joint between the head of the metacarpal and that of the adjacent bone. The lateral ligaments of the metacarpophalangeal joint are cut through on each side. The joint is then irrigated through and through with 1 per cent. phenol solution. The wound on each side is packed wide open with gauze saturated with camphor-phenol. The packing should not enter the joint.

If infection has been present for several days and the web space is already the seat of purulent exudate, through-and-through drainage of the web space should be established by a counter opening in the palm, as for drainage of the collar-button abscess of the web space. By early incision and drainage, even if the synovial fluid is already turbid, the joint usually heals without prolonged suppuration.

Septic Arthritis of the Wrist-joint.—The wrist-joint becomes invaded through compound injury, such as small penetrating wounds, large crushing injuries, and compound dislocation. It is also not infrequently involved by extension from septic tenosynovitis of the radial bursa and from osteomyelitis of the adjacent bones. The general symptoms of infection are more marked than with the smaller joints. Locally the wrist and hand are swollen, the tissue over the wrist is tense, and the line of the wrist-joint and area of the carpus are exquisitely tender to deep pressure.

TREATMENT.—When, in the course of septic tenosynovitis or following wounds of the wrist-joint, it is evident that the wrist is infected, it should be assumed that the infection is of a septic nature, demanding immediate drainage of the wrist-joint. Idiopathic arthritis should be proven of septic nature by aspiration and culture, or by exploratory puncture before establishing drainage. Drainage is established by dorsal and volar incisions, 4 in number, over the carporadial articulation, 1 between each styloid process and the adjacent group of tendon sheaths. Drainage is maintained by half a dozen strands of silk-worm-gut passed from each wound to the adjacent one. Active hyperemia is maintained by soaking the forearm in hot boric solution 15 minutes out of every 3 hours. The drains are withdrawn in 3 to 6 days and the wounds are superficially opened from time to time by spreading with artery clamp. Occasionally the process subsides completely. Usually the sinuses persist for 6 weeks, when the wrist heals with fibrous ankylosis of the various joints.

When drainage is not promptly established, the carpus may become the seat of an osteomyelitis.

A more radical plan of drainage and one which should be adopted in the presence of long-continued or acute violent sepsis, is the removal of the proximal or both rows of carpal bones. The best results, however, are secured without resection, by prompt drainage, by using as little foreign drainage material through the joint as is possible, by maintaining drainage for a short time only, and by avoiding secondary infection.

For the end-result of suppuration—namely, an ankylosed wrist—various

forms of arthroplasty with transplantation of soft parts into the joint have been suggested and practiced.

ACUTE LYMPHANGITIS

The fingers and hands are richly endowed with lymph supply. The spaces and finer vessels of the fingers drain into 4 lateral trunks, 2 on each side of the finger accompanying the blood-vessels. These course superficially through a plexus in the interdigital web, and pass up the back of the hand into the forearm. The lymph drainage from the superficial layers of the hand, even from the palm, is practically all toward the dorsum into the large superficial trunks running in the subcutaneous tissue of the back of the hand. The scanty lymph system of deep tissue drains along the deep lymph vessels which accompany the radial and ulnar arteries.

Practically all infections of the hand, even of the palm, give greatest lymph accumulation in the loose tissue of the interdigital web and the dorsum of the hand.

Etiology.—The infecting organism is usually the streptococcus, commonly a hemolytic strain. The staphylococcus aureus is, however, occasionally found. The infecting organism finds ingress usually through a trivial wound, such as a prick or abrasion.

Pathology, Symptomatology, and Differential Diagnosis.—The reaction rarely goes on to pus formation. Cellulitis with abscess formation and lymphangitis each present as a sharply distinct type of infection. They are associated only in a small proportion, less than a fifth, of the cases going on to pus formation.

The local lesion is rarely more than a blushed area, possibly a slight blister or small black scab, often so trivial as to pass unnoticed. As compared with cellulitis, the reddening from lymphangitis is of brighter hue, fading off gradually into the normal; the tissue is not so tensely distended, nor is it so exquisitely tender to pressure as when pus is present. In the larger channels, the straight, bright-red, and slightly raised and tender streaks are characteristic, converging into the epitrochlear region and into the axilla. The general intoxication is usually greater than with localized cellulitis.

When the lymphangitis does go on to suppuration, this more commonly occurs where the vessels are least supported and lymph most readily pockets, as, for example, in the web space, the dorsum of the hand and at the valves along the trunks through the forearm.

Types of Lymphangitis.—The following types may be distinguished:

TYPE 1: MILD ACUTE LYMPHANGITIS.—From a locally blushed spot or insignificant abrasion, several red streaks may be traced in straight course up the forearm and into the midaxillary group of lymph glands. These may be slightly swollen and tender. There is usually general malaise and slight febrile reaction. If the patient reacts well to the invasion, the local process and streaks may disappear spontaneously within 12 hours and the glandular swelling after a day or 2.

TYPE 2: MILD ACUTE LYMPHANGITIS WITH MINOR LOCAL COMPLICATION.—In a more persistent type of inflammation, the round-cell infiltration at the site of invasion and along the lymph channels and in the glands may not resolve for several days. In this event abscess may form at the site of inoculation or along the lymph trunk, or in the lymph-node receiving the maximum drainage. When the primary infection occurs in the small and ring finger, the lymph-nodes principally affected will be found in the epitrochlear region. The rest of the hand drains primarily into the midaxillary group of glands, the small toe and outer border of the foot into the popliteal space, and the balance of the foot into the lower chain of the inguinal glands. With suppuration mild constitutional symptoms are present.

TYPE 3: SEVERE ACUTE LYMPHANGITIS WITH SERIOUS LOCAL COMPLICATION.—In a third type the lymphatic infection extends into the tendon sheaths or the fascial spaces or into the subcutaneous tissue and produces abscess. The sheaths and fascial spaces become opened to infection most commonly through the original wound or by misguided incision. In these extensions the systemic intoxication is of added severity both from the wider primary area of absorption and from the fresh area opened to absorption by the surgeon in instituting drainage.

Serious phlegmonous extension to subcutaneous tissue is seen most commonly in the forearm. Associated with streaks of superficial lymphangitis or by infection along deeper channels, the forearm becomes greatly swollen, tense, and tender. The skin is leather-like in consistency and pits only on prolonged pressure. It is covered by small blisters and blebs. It may be whitened or grayish at the center of active inflammation, reddened at the periphery, gradually shading off to normal in the arm or shoulder. The condition is sometimes spoken of as phlegmonous erysipelas, but the inflammation is not restricted as in erysipelas to the skin proper, nor is the line of inflammatory demarcation so sharply defined. The subcutaneous tissue becomes bloated with cloudy serum and finally sloughs. The skin becomes the envelope of great subcutaneous abscesses and may itself slough over a wide area. The accompanying constitutional symptoms are severe.

TYPE 4: SEVERE SYSTEMIC ACUTE LYMPHANGITIS.—If the organism proves, for the moment, of uncontrollable virulence, the case is characterized by alarming systemic symptoms, often associated with trivial local manifestation. There may be a chill and high rise in temperature, the patient is prostrated and looks haggard, of whitish or of yellow tinge; in other words, the typical picture is that of a severe systemic poisoning. The patient may react favorably after a day or weeks of intense sepsis and recover, or may succumb to an intense bacteriemia, septicemia, pyemia, or thrombotic, pneumonic, or other septic complication.

Treatment.—The treatment largely hangs on the diagnosis. If the inflammation is suppurative, drainage should be promptly instituted. On the other hand, if the inflammation is pure lymphangitis and incision is made before a

localizing process has been well walled off, incision is fraught with danger. It is found clinically that incision into the local site of invasion, or deeply across the lymph channels or into the tender lymph glands is followed by a violent increase in constitutional toxemia.

In refraining from incision, the surgeon is chiefly guided by the character of lymphatic inflammation, the bright coloration, the light character of the throbbing pain, and the absence of the acute or exquisite deep tenderness which chiefly characterizes the early presence of pus. It requires rare surgical courage and judgment to refrain, on the one hand, from incising these violently septic cases and, on the other hand, to avoid unnecessary delay in draining deep collections of pus.

The general treatment consists of rest, abundance of water and other liquids, mild catharsis, and general supporting measures. It is an open question whether medication, except such as supports the patient's strength, is of any avail. If the surgeon elects to direct systemic measures specifically against the infecting organism, he should choose some of the measures of least potential injury to the patient, such as injection of streptococcus antitoxin or colloidal silver. He should not overwhelm the resistance of the patient by vaccine, "phylacogen," and other toxic agents.

As local measures, in the comparatively mild cases of lymphangitis the following suffice. The extremity should be elevated, put at rest, and supported by a gauze bandage from the finger tips to the axilla. Hyperemia should be induced, preferably by alternate heat and cold, ordinarily by wet dressing. For example, the extremity is soaked for 15 minutes every 3 hours in hot boric solution at 112° F. The dressing is then allowed to cool by evaporation. Aluminum acetate solution may be used also. Phenol solution is widely interdicted, being highly toxic, particularly deadly to small parts, such as the finger tip. Even dilute solution, 1/2 per cent., may cause local gangrene and systemic intoxication to the extent of smoking the urine. Yet the use of phenol should not be absolutely prohibited. In my experience, in controlling the most violent cases of superficial lymphangitis and epitrochlear and axillary lymphangitis, weak phenol solution applied to the forearm and arm has proved the most efficacious of all wet dressings. Its use should be limited to the first 12 hours, and not stronger than 1 per cent. solution should be used, carefully avoiding wetting the hand portion of the dressing with phenol. The hand portion is kept moist with boric acid solution. The application of phenol should not be renewed repeatedly, but should be replaced when evaporated by boric acid solution. After the first 36 hours, gentle heat by blanket and electric poultice is preferable to wet dressing.

With acute and violent general toxemia, instead of employing active hyperemia by the foregoing thermal methods, it seems to be advantageous for the first 18 or 24 hours to induce passive hyperemia by the Bier method of constriction, blocking back the lymph and blood flow until the body can react to the intoxication. For this purpose a broad rubber or gauze bandage is bound

around the middle third of the arm, sufficiently tight to produce a faint bluish reddening of the forearm with slight edema after a few hours. The constriction should not cause pain nor profound congestion.

Constriction hyperemia should also be induced at a later period in the highly septic cases, when ill-advised incision has opened non-suppurating fresh tissue to septic absorption. Additionally these fresh wounds should be cauterized with phenol and packed with camphor-phenol gauze to avoid spread of infection and violent increase in constitutional intoxication.

In the unusual event of superficial pus formation or extension to tendon sheath, joint, or fascial space, the localized complicating lesion should be opened and drained. The chief fight against infection is the systemic one; therefore, it is well to wait for definitely localized tenderness or definite induration to declare the local presence of pus before incising. The tendon sheaths, joints, and fascial spaces may be drained as indicated in the previous section. Phlegmonous infection of the forearm should be drained by multiple short incisions, 2 in. long, placed over and peripherally to the most indurated and tender area. Manipulation should be gentle; undermining in the subcutaneous tissue should be done gently with the finger. Subsequent small incisions, as indications arise, are preferable to immediate sweeping dissection which may overwhelm the patient by sudden toxic absorption from a large raw area.

Long incision and sweeping dissection of fascial planes in acute phlegmon are indicated only in infections caused by anaërobic organisms. Thus, in infections by the bacillus of malignant edema and by the bacillus *aërogenes capsulatus*, the infected tissue should be incised, packed wide open and the extremity should be soaked in weak iodine solution (1:2,000 in water). In rapidly advancing liquefaction of tissue by mixed aërobic and anaërobic infection, as in the old-time hospital gangrene, the sloughing area should be cauterized by liquid bromine and the spreading cellulitis treated by incision and iodine bath.

MISCELLANEOUS AND CHRONIC INFECTIONS OF THE HAND AND FOOT

Furuncle.—Furuncle occasionally occurs on the dorsum of the hand. It is treated as furuncle elsewhere, preferably waiting until there is central destruction, then crucially incising and packing with a wick of camphor-phenol gauze.

Carbuncle.—This lesion should be promptly and effectively drained as carbuncle elsewhere, by crucial incision carried well past the zone of induration. The 4 quadrants of the infiltrated skin and subcutaneous tissue are raised from the deep fascia by under-cutting with scalpel, dissecting back each quadrant well past the margin of induration. The cavity so dissected is packed with camphor-phenol gauze, replacing the quadrants on the packing until the sloughs have separated. Any subsequent extension of induration is met by extending the under-cutting.

Excision of the carbuncle, as is so commonly advised, needlessly sacrifices large viable portions of skin which overlie the carbuncle, thus prolonging the stage of recovery and increasing the scar deformity.

Erysipeloid.—Erysipeloid is an infective dermatitis seen most commonly in the hand and caused by some low-grade meat-contaminating organism, probably the cladothrix described by Rosenbach. The disease usually starts on the finger after a knife wound or an abrasion or laceration, as from crab bite, usually when handling dead animal matter, such as raw meat, fish or cheese. Therefore, the disease is commonly met with in butchers, cooks, fish-dealers, and fishermen. A few days after the injury, the immediate neighborhood of the wound presents redness, swelling, slight heat, some discomfort on pressure, and throbs slightly. The border of the reddening is raised and sharply marked from the healthy tissue. This sharp red line gradually advances down the finger into the hand and thence to other fingers, often wandering about for 6 weeks or more, until it terminates in spontaneous cure. The disease rarely passes above the wrist and is seldom seen on the feet or elsewhere on the body. The affected area gradually fades behind the line of advance and after undergoing brawny desquamation becomes normal. The history and sharp line of demarcation are characteristic, yet in practice it is common to see these lesions mistaken for cellulitis and incised, particularly by the surgeon untrained in hospital out-patient surgery.

Treatment.—The condition yields readily to application of 25 per cent. ichthyol ointment, usually within 4 days. Relapse is common; therefore, the treatment is continued at intervals for another week. Local application of liquefied phenol until the skin is white, followed by neutralization with alcohol, is also effectual but somewhat more drastic. Salicylic ointment is said to be effectual.

Rheumatic Tenosynovitis.—Rheumatic tenosynovitis may be differentiated from suppurative infection by the milder character of the symptoms, together with the presence of arthritis in distant joints and absence, in the history, of injury. Rheumatic tenosynovitis is treated as other complications of acute rheumatism, i. e., by the salicylates.

Gonorrheal Tenosynovitis.—Gonorrheal tenosynovitis is usually of slower onset and less violent than the pyogenic variety. It occurs most commonly on the extensor sheaths of the wrist. Usually there is a history of urethritis or the presence of the characteristic diplococcus in smear. When the symptoms are acute and so intense as to resemble the more common suppurative infections in the sheath, the sheath should be opened at each end, washed through with 10 per cent. protargol or 1 per cent. silver nitrate solution. The skin may be loosely sutured without drainage. This procedure is usually followed by a prompt subsidence of symptoms.

Tuberculosis.—Tuberculosis in the extremities is particularly amenable to the less radical surgical measures advocated in recent years. The general treatment consists, as elsewhere more fully outlined, in increasing the systemic re-

sistance through good nourishment, outdoor life and vaccine therapy. The local treatment consists in rest, in activation of local resistance by hyperemia and in control of mixed infection. The part is put at rest by splint or bandage.

Hyperemia is induced preferably by constriction. The patient is taught to apply a wide rubber bandage to the arm so that the veins of the forearm are engorged and the hand is distinctly bluish. This band should be worn for about 2½ hours night and morning, usually for from 6 to 18 months. Hyperemia by ultraviolet stimulation, preferably by the sun rays, is also a most useful measure. For such heliotherapy the extremity should be exposed in the open air 2 hours or more each day to the direct rays of the sun, avoiding at first excessive sunburn. Active hyperemia produced by heat, as by baking, is not so efficacious, and at times seems definitely harmful.

The control of mixed infection by medication directly applied to the infected sinuses is practiced as follows: The infected sinuses may be cleansed and kept open by probing every few days with a probe moistened in phenol. The tract, if short and straight, may be swabbed occasionally with iodine. If the tract is long and poorly drained, it should be distended by injection with 10 per cent. mercurial or 30 per cent. bismuth ointment. The tract thus becomes cleansed of mixed infection, granulation is stimulated by pressure, and drainage is freely established alongside the ointment. This injection may be repeated from time to time if the tract does not heal. A drug which finds its widest field of usefulness in cleansing and stimulating these lesions is iodoform, 10 per cent., in ointment, or injected, 10 per cent. or more, suspended in glycerin. This may be used occasionally as alternate for the mercury ointment injection.

OPERATIVE TREATMENT.—The removal of disorganized bone and tuberculous soft parts is advisable when the local process has resisted long and faithful application of the foregoing milder measures. In fact, radical excision is advisable as a preliminary measure when the diseased bone or other tissue, such as tendon sheath, can be removed completely and without crippling or unsightly deformity.

Following the radical excision, the resistance should be increased by continuance, for some months, of the foregoing general measures and passive hyperemia.

Tuberculous Dactylitis.—Tuberculous osteomyelitis of the phalanges should be persistently treated for several years by the above palliative measures. If the lesion persists, the entire diseased bone should be removed by subperiosteal resection through a lateral incision.

Tuberculous Tenosynovitis.—The extensor tendons of the wrist are the most commonly infected.

In the serous type of tenosynovitis, the sheath may be opened and swabbed with tincture of iodine and impregnated with iodoform powder or with iodoform suspended in glycerin. The wound is then sutured without drainage.

When rice-like bodies are present in the sheath, a wider exposure must be

made and the sheath wiped free of foreign material by forcible rubbing with gauze. The wound is then treated as in the foregoing type.

In the fungous and caseous type of tuberculosis, the best results are secured by excision of tuberculous tissue together with the foregoing treatment of the wound by iodoform and after-treatment by constriction hyperemia.

Tuberculosis of carpus and tarsus is treated along the same general lines. The subject is considered in detail elsewhere.

Other Infections.—Syphilitic dactylitis and other syphilitic manifestations of the hand and foot are treated as syphilis elsewhere.

Anthrax, glanders, blastomycosis, yaws, and other infections may find ingress through wounds of the hand or foot, or may secondarily extend to these extremities. They are considered under the respective subjects.

TUMORS OF THE HAND AND FOOT

Introduction.—Any tumor may be found in the hand or foot which arises from epithelium, connective tissue, bone, or other component tissues of the extremities. Only those tumors will be considered in this section which are especially common or which present special points of diagnostic interest bearing on prognosis and treatment. Also there is included a certain group of borderline chronic inflammatory changes in epithelium and connective tissue occasionally mistaken for malignant tumor.

Inflammatory Hyperplasia Occasionally Mistaken for Malignant Tumor.—**GRANULOMA OF THE FINGER.**—The presence of a chronic irritant in the finger tip, such as a foreign body in the pulp or, more commonly, a detached edge of finger nail overhanging an infected area, results in exuberant masses of granulation tissue. The masses of granulation tissue may persist for such length of time and become so organized as to resemble a true tumor. Histologically they may be confused with round-cell, spindle-cell, or giant-cell sarcomata. Unless the irritant is removed, the granulation tissue promptly recurs after being trimmed off. When the irritant is removed, as, for example, in granuloma of the nail-bed by removal of the entire nail, the inflammatory tissue becomes absorbed. In those granulomata which arise without evident cause, the possibility of the granuloma being an initial lesion of syphilis must be borne in mind.

IRRITATIVE CHRONIC DERMATITIS.—From the exposed position of the hands to various chemicals, such as coal-tar products, and to certain physical irritants, such as X-ray, there may occur a roughening of the epithelial layers and fibrosis of the deeper layers of the derma. The epithelium grows irregularly, is hypertrophic in spots, in others atrophic, and the surface becomes marked by cracks, fissures, and excoriations. The condition is analogous to leukoplakia of the tongue and, like this condition, may become the seat of malignant epithelial change. The histological diagnosis must be made with the utmost caution to avoid such error in diagnosis as would lead to unneces-

sary amputation of the fingers and hand. The appearance of the other parts of the hand equally diseased and the gross appearance of the suspected area should bear equal weight with the microscopical findings.

TREATMENT.—Prior to definite malignant change, the treatment consists in withdrawing the irritant, the use of antiseptic and astringent washes, the application of bland ointments, and protection from ordinary trauma by wearing gloves. Malignant change must be constantly watched for and promptly eradicated by minor amputation, or, later, by wider amputation with glandular removal. The frequency of this dermatitis, particularly that from X-ray burn, is being progressively lessened by more general knowledge of the dangers from constant exposure to this and the various chemical irritants.

Cellular Tumors Occasionally Mistaken for True Sarcoma.—**XANTHOMA.**—This flat yellow tumor, commonly observed on the eyelid, is also found on the hand. Histologically it is a very cellular tumor and may be mistaken for sarcoma. In sending such a tumor for microscopical diagnosis, the surgeon should include the history and the color of the tumor, to guard against mistake in histological diagnosis. When on guard and by staining for the characteristic fat cells, the pathologist readily differentiates the tumor from sarcoma.

TREATMENT.—The tumor may be excised if cosmetically desirable. In prognosis the surgeon should state in substance that similar tumors may develop on the hands or elsewhere, but that these will have no metastatic relationship with the original tumor.

MYELOID ENDOTHELIOMA.—This is a slow-growing firm fibrous tumor, one of the most common tumors of the finger. It usually arises from the flexor tendon sheath. The histological origin is in dispute. It is analogous to epulis of the tooth socket and by some pathologists is classified as a giant-cell sarcoma. It commonly presents as a knobbed cartilaginous enlargement on the side of the finger or may completely encircle the finger moulding itself to bones and soft parts. It may be of many years' slow growth.

TREATMENT.—On freeing the tumor from beneath the fascia by a lateral incision, the tumor shells out easily from beneath the distended and thickened deep fascia of the finger. The tumor is usually found adherent only over a small area of the flexor tendon sheath. The point of attachment, together with a margin of surrounding sheath, should be excised. No attention need be paid surgically to the denuded tendon, as the sheath promptly regenerates.

The growth rarely recurs when thus excised and no alarm need be taken if the tumor is reported as sarcoma. This and the chronic granulomata belong to that class of tumors which are liable to be mistaken for malignant growths by the histological pathologist, either through intimidation by the overzealous clinician or by the microscopist not possessing full knowledge of the clinical course and gross appearance of the tumor in situ. It may be mentioned in passing that the foregoing chronic inflammatory and these clinically benign tumors have not infrequently found their way into literature as malignant

tumors reported cured by erysipelas toxin and other empiric, bizarre, and worthless methods.

Benign Tumors.—**FIBROMA AND LIPOMA.**—These slow-growing and benign tumors may occur in the fingers, hand, and foot. Usually they present as well encapsulated, lobulated tumors, tending to mould themselves to surrounding structures. Thus, these tumors in the fingers, although they may prove, when excised, to be elongated and lobulated, are so moulded in situ beneath the deep fascia of the finger that they may present as a symmetrical fusiform enlargement of fingers. They may be displaced by gradual pressure. Thus a lipoma beneath the distal portion of the plantar fascia, as it enlarges, may be crowded between the metatarsal bones into the dorsum of the foot. When subjected to constant pressure, a painful bursa may arise over or in the substance of these tumors. They are for the most part readily decapsulated and excised under local anesthesia.

CHONDROMA OF THE FINGER.—The fingers are favorite sites for multiple chondromata developing in rests from the epiphyseal line of the phalanges and metacarpal bones. They may be attached by a sessile or pedunculated base to the bone beneath. Some of the more sessile tumors appear as a bunch of grapes on the fingers and are fairly movable beneath the skin. Many of the so-called chondromata, particularly of the first and fifth metacarpal bones, histologically prove to be rudimentary supernumerary digits.

TREATMENT.—If desired for cosmetic or mechanical indication, the tumors may be removed by decapsulating the entire tumor from the surrounding soft parts and excising it together with a small chip of normal bone beneath the attachment.

INCLUSION CYSTS OF THE HAND.—The palm of the hand and the sole of the foot are so commonly the site of puncture by blunt objects that inclusion cyst is one of the most common tumors of those regions. By such an injury a particle of skin may be planted into the deep parts, where it may lie quiescent for many years. Finally a rotund elastic tumor or a gradual bulging of the palmar or plantar fascia develops.

On incision down to the tumor, a well encapsulated doughy tumor may be enucleated, histologically a dermoid cyst.

GANGLION.—These synovial cysts are usually formed, according to Clarke, by a retrograde physiological metamorphosis in the connective tissue in the neighborhood of normal synovial development. The tumor is most commonly seen over the back of the wrist attached to the extensor tendon sheaths.

TREATMENT.—Occasionally the swelling disappears spontaneously, particularly when of rather acute development. The preferred treatment is excision, but when this is refused for cosmetic or any other reasons, less radical curative measures may be employed. Occasionally the cyst may be ruptured with immediate, often permanent disappearance of the tumor by a sharp blow with a small stiff book. It may also be dissipated by aspiration of the synovial contents or by puncture with a tenotome. If it reappears, excision is the operation of choice.

Malignant Tumors.—**SARCOMA.**—True sarcoma is seen more commonly in the hand than in the foot. It should be treated by amputation at the next proximal joint or higher. With these tumors, the melanotic variety in particular, careful search should be made for distant metastases before operating, to avoid useless amputation.

EPITHELIOMA.—Epithelioma is somewhat more common on the foot than on the hand. It should be treated by wide amputation, as, for example, at the ankle or lower third of the leg, together with complete glandular dissection of the popliteal and inguinal regions.

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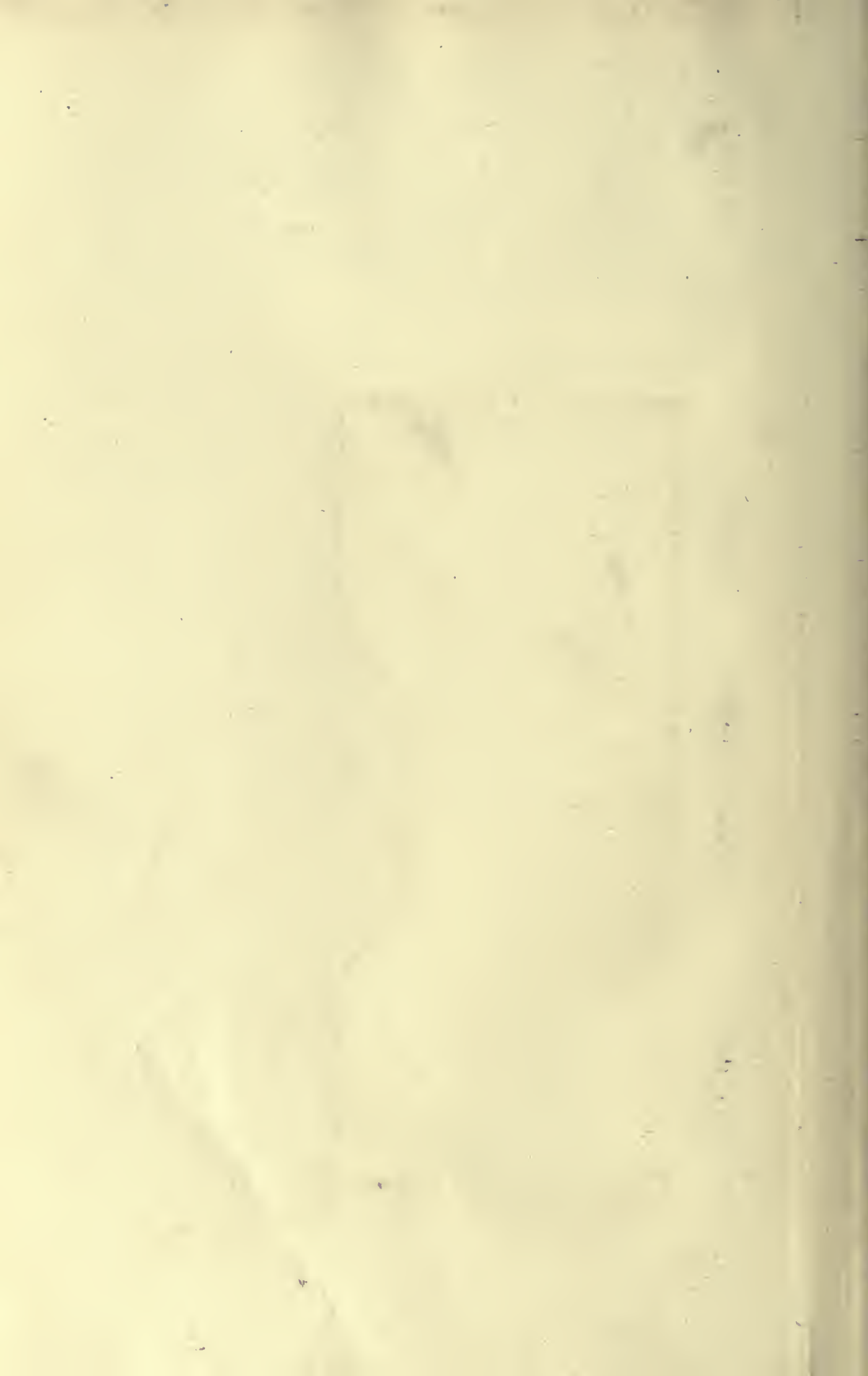
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